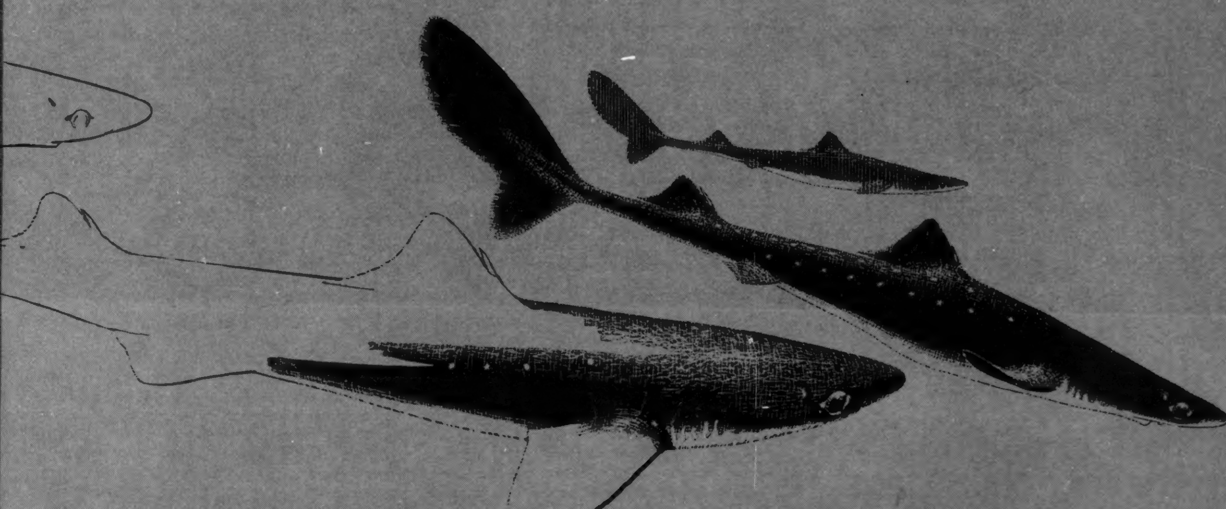
Marine Fisheries REVIEW

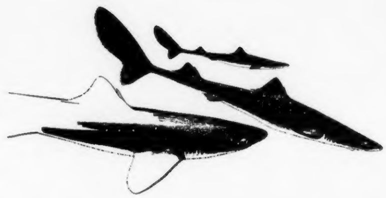
April 1979

National Oceanic and Atmospheric Administration • National Marine Fisheries Service



Dogfish

Marine Fisheries REVIEW



On the cover: World dogfish markets and catches are reviewed in the news item beginning on page 34. Illustration by Harold L. Spiess.

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High Quality Frozen Seafoods: The Need and the Potential in the United States

J. T. R. NICKERSON and L. J. RONSIVALLI

Introduction

The passage of the Fishery Conservation and Management Act of 1976, which brings relatively rich fishing areas within the newly established 200-mile jurisdictional boundary off U.S. coasts, makes possible larger catches for U.S. fishing vessels. And, since the overall harvesting pressure will be markedly reduced due to reduction in foreign fishing, replenishment of important species such as haddock will eventually result in the availability of even more fish to catch. Thus, there is the potential for the United States to once again become one of the top fishing nations of the world—a desirable position for this country.

Increased landings would reduce this nation's heavy dependence on imports, making it less vulnerable to the vagaries of international competition for edible goods. Increased landings would also tend to improve our position in international trade, especially if we could catch enough fish to not only satisfy the bulk of our demand but to increase our exports significantly. This would, of course, be associated with an increase in processing effort and corresponding increases in ancillary business activities.

Even though it may be too soon to expect any sizeable increase in the fish stocks, evidence of an impending seafood bonanza is reflected in an unusual increase in harvesting capacity and a burgeoning interest in the various elements of the seafood industry.

The potential for increased seafood harvests goes beyond the simple economics of increasing the domestic output. It could account for a significant increase in the per capita consumption of seafoods in this country (per capita consumption equals the total number of pounds of seafoods consumed in 1 year divided by the total population). In the United States this is about 12.5 pounds, and it has not changed much in decades, despite the fact that fish offer unique nutritional and perhaps therapeutic advantages as protein foods. Thus, increased domestic landings might result in a higher per capita consumption which would benefit the health of consumers as some of the meat in the diet became replaced with fish and fish products, especially those that are low in fat.

To get some perspective of the quantity of the increased landings that is possible, it should be noted that foreign vessels harvested an estimated 3.7 billion pounds of fish during 1977 in the U.S. fishery conservation zone (within the 200-mile limit). While it is not practical to anticipate that the United States could actually increase its landings by that much, certainly there is no reason why U.S. fishermen could not gear up to catch the bulk of that amount.

In the United States, fish are largely consumed as fresh, frozen, canned, and cured. Should the per capita consumption increase, it is believed that the bulk of the added consumption would be in the form of frozen products, even though it is expected that there would be a sizeable increase in the consumption of fresh products. Currently there are indications of increased sales of fresh fish in various parts of the country, especially where attempts are made to control the quality of the products. While the growth is largely in coastal areas, the use of air transportation has made possible the delivery of high-quality fresh seafoods to inland areas. Indications are that quality is so important to consumers that they are willing to pay the added costs that are incurred to maintain quality. The added costs include those for inspection, prepackaging, proper refrigeration, and special handling. As a matter of fact, it has been speculated that the outstanding

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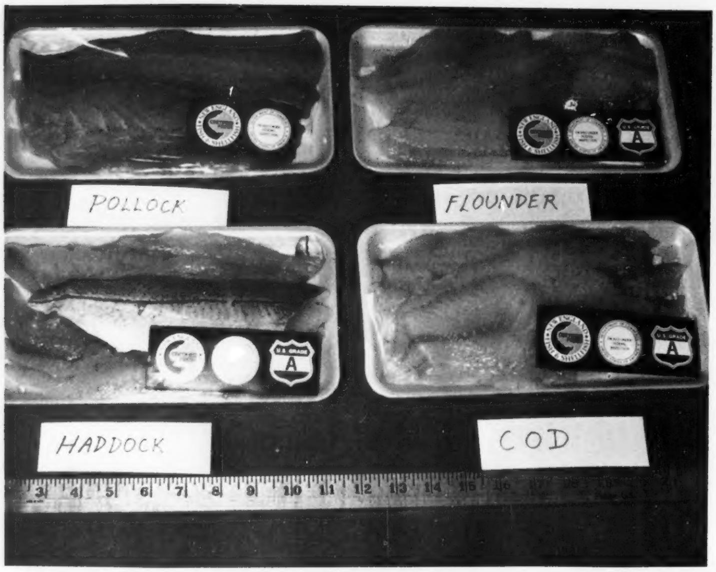


Prepackaged U.S. Grade A fish fillets.

reason for the low per capita consumption of fish in the United States is the unreliability of its quality at point of sale. A recently completed 2-year study by the National Marine Fisheries Service demonstrated that when quality was assured to be U.S. Grade A at point of sale, there was a measurable increase in sales, up to 20 percent (Ronsivalli et al., 1978). However, the distribution of fresh fish is associated with losses due to spoilage, limited distribution due to the short shelf life of the product, mishandling due to laxity, large fluctuation in price due to the sharp shifts in the supply-to-demand ratio, and unreliability of supply due to the variety of reasons why fish are sometimes not landed in sufficient amounts. (Many vessels either do not go to sea or, if at sea, cannot harvest fish effectively during stormy weather, adequate catches are not always made, malfunction of gear, accident, etc.)

The logical disposition of additional landings would be to preserve them by freezing as fillets, fillet blocks, whole fish, steaks, and prepared products. In the first place, preserving fish by freezing keeps them at near initial quality when they are properly handled, packaged, and stored. Also frozen products can be held for quite long periods (more that 1 year). Thus, large landings could be frozen and stored. (Otherwise, in many cases large landings currently command a relatively low price per pound.On the other hand, prices make a sharp rise when landings are low.) By freezing fish during times of glut, the supply during lean times could be assured, and this would result in stabilization of both the prices at retail and the reliability of supply all year round for the consumer, the institutional user, and the processor. When fish are properly frozen and properly handled, the long storage life that results permits distribution anywhere in the world, provided that the transportation vehicle is capable of providing the necessary refrigeration capacity. The economic potential for handling fish in the frozen form is evidenced by the fact that fast-food chains use only frozen fish for their fish sandwiches, the high quality of which is indicated by the strong sales growth of this commodity. Also, the notion that frozen fish is not as good as fresh fish in quality is not supported when one compares the quality of fish in the fast-food chain sandwiches with the quality of fresh fish. The facts are that the frozen fish that become fish sandwiches in fast-food chains are of high initial quality, and are properly frozen and handled, whereas frozen fish that are eventually sold in the retail cases of supermarkets are of variable quality initially and maybe frozen and handled in less than satisfactory fashion. This can result in products that may be rancid, tough, dehydrated, and generally unacceptable.

What is Needed

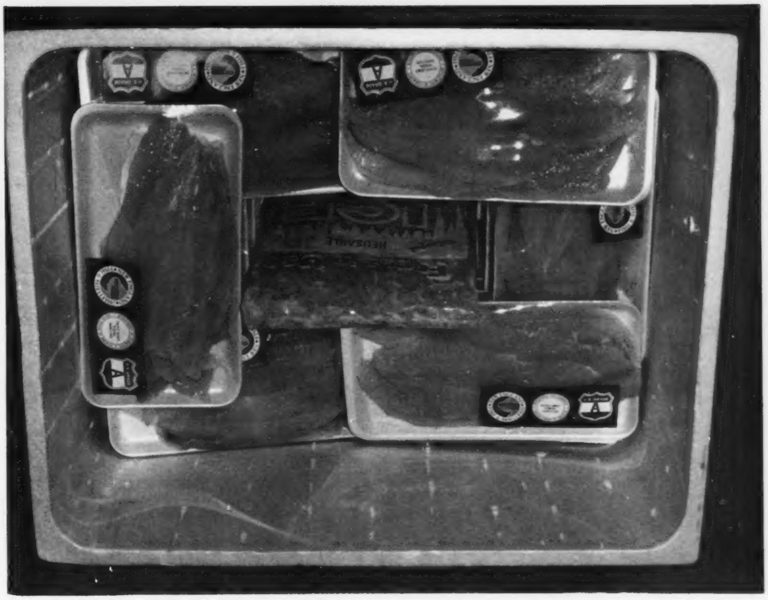
For more than a decade the Consumers Union[1] and other consumer groups have published articles condemning the quality of fishery products that are available to the consumer. In one article (Anonymous, 1961), the religious connotation of fish as a pennance food is attributed to the image of poor quality with which it has long been associated. A recent study (Ronsivalli et al., 1978) has demonstrated beyond doubt the customer satisfaction and demand gained by controlling the quality of the product. While freezing is theoretically the preferred method for preserving fish, certain changes in attitude and procedures will have to occur in the way fish are harvested, processed, packaged, transported, stored, and displayed at retail if we are to produce high quality frozen fish.

Temperature Control

The shelf life of fresh fish at 32° F is about 2 weeks. Its quality remains at Grade A for about 1 week. Both the shelf life and the time during which the product remains at Grade A are shortened as the holding temperature is increased. Thus, since much of the U.S. catch is landed unfrozen, it can be seen that the length of time and the tem-

[1]Reference to commercial firms or groups does not imply endorsement by the National Marine Fisheries Service, NOAA.

perature at which fish are kept aboard the fishing vessel and elsewhere, until they are frozen, will determine the quality of the product at time of freezing. Aboard the fishing vessel, fish will have to be well iced (Dassow, 1976), preferably in boxes, or they may be held in chilled seawater (Hulme and Baker, 1977), and, at that, they should not be held for longer than 2-3 days. It can be seen from this that whether vessels are bringing in fish that are to be handled as fresh in the distribution chain or as frozen, it appears that they cannot make trips that are longer than 2-3 days, unless (for fish to be sold as frozen) they have the capacity to freeze all fish that might conceivably have to spend more than 2-3 days before they can be processed on land. There is no alternative to these guidelines, which will add to the cost, but the extra cost involved in following them will be returned in enhanced image, less waste of resource through spoilage, satisfied consumers who are willing to absorb the extra cost (Ronsivalli et al., 1978), etc.



Preparing U.S. Grade A fish fillets for shipment.

Whether increased landings are frozen at sea or (as appears most likely for most U.S. vessels) on land, the product must be frozen as soon as possible. It must be packaged so as not to lose moisture nor to be exposed to oxygen, and throughout its distribution and storage, its temperature should not be allowed to exceed 0°F.

Warehouse and Freezing Capacities

To hold frozen products for varying lengths of time, considerable warehouse space will be needed. At present, the processors of marine products do not have capacity to freeze and store large quantities of fish and shellfish. There should, therefore, be a considerable investment in both—whatever equipment may be necessary for the freezing of predictable increased amounts of marine products as well as for the storage of these products at suitable low temperatures. This should enable processors to take care of their needs for further processing as required in the production of such foods as fish sticks and fish portions and also provide for increased retail sales of frozen fish fillets.

Packaging

The packaging of frozen marine products under current practices is almost totally inadequate. Almost all packages used for these foods offer little barrier to moisture loss or to the entry of oxygen. Thus, dehydration occurs, accelerating both rancidification and toughening (denaturation of proteins), and, of course, since these packages allow the diffusion of oxygen, oxidation, which causes rancidification, is further accelerated. Another deficiency of packaging for products such as breaded shrimp is the space within the package that is not occupied by the product. This leads to dehydration of the food, reduced net weight, cavity-ice formation, and deterioration of the quality of the product during frozen storage.

Many packaging materials, including polyesters, polyvinylidene chloride, and aluminum laminates are presently available for frozen foods which will prevent dehydration of the food and the diffusion of oxygen, hence preventing oxidation and rancidification. They also provide for packing the food under a vacuum, hence eliminating empty space within the package and thus the formation of cavity ice. This type of packaging is more expensive than the inadequate ones which are mostly in use today, but, considering the present average cost of fish and shellfish to the consumer, it should be no deterrent to add the price of adequate packaging to seafoods. This is especially the case since, in the long run, the consumer would benefit by receiving a food of much better quality. At present, it is very difficult to buy salmon and mackerel, during winter months, which are not rancid. If packaged properly there is no reason that it should not be possible to obtain good quality salmon steaks and mackerel fillets at any time of year. This is especially the case with these fish since they are not subject to toughening or to denaturation of their proteins. It should be noted

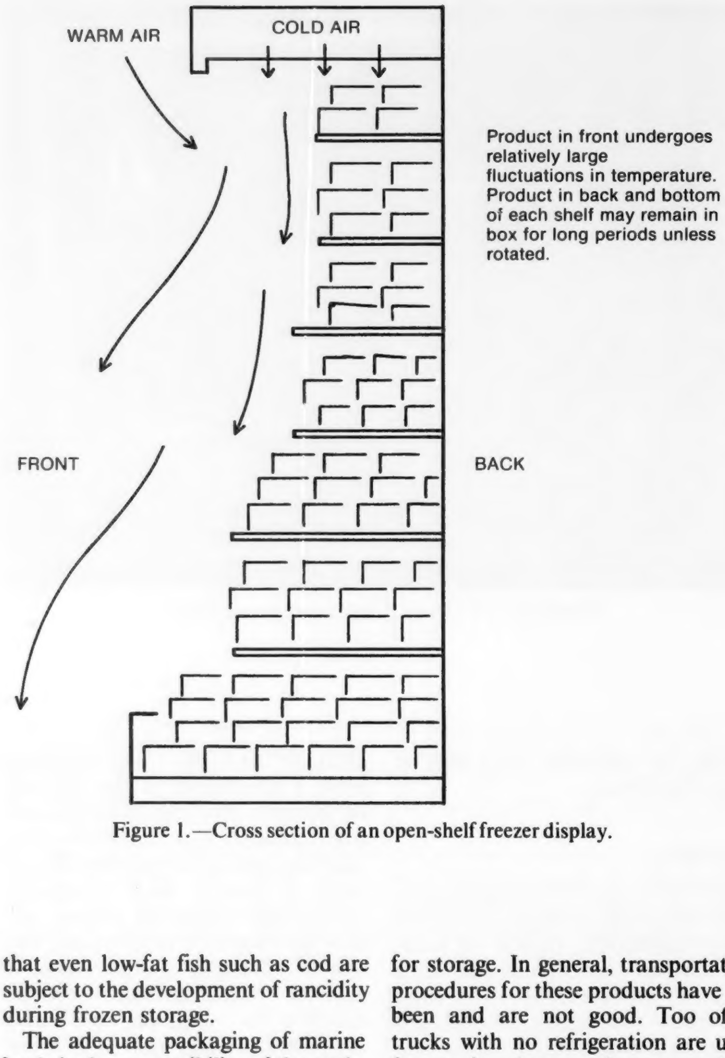


Figure 1.—Cross section of an open-shelf freezer display.

that even low-fat fish such as cod are subject to the development of rancidity during frozen storage.

The adequate packaging of marine foods is the responsibility of the packer, and until there is a change of attitude in this respect, there can be little improvement in the quality of frozen marine products.

After packing and freezing, fish and shellfish should be held at 0°F or below. Generally the packers of such foods have done a good job in this respect.

Transportation

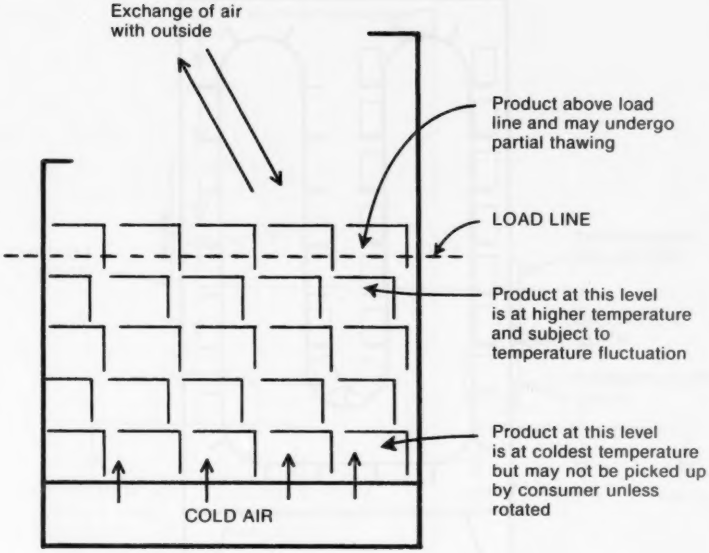
Frozen foods must be transported from the point where they were produced to the point where they will be retailed or consumed or to a warehouse for storage. In general, transportation procedures for these products have not been and are not good. Too often trucks with no refrigeration are used for moving these products over short or even somewhat longer distances and, for long hauls, inadequate refrigeration is used and some truck drivers have been known to sometimes shut off the refrigeration system even when it was available. Thus, oftentimes the already frozen load is depended upon to provide the refrigeration within the carrier. It has been stated that "frozen foods have a memory," which means that any time they have been held, even for short periods, above suitably low temperatures, and especially above 0°F, the produce undergoes some deterioration and that this deterioration will result in a shortening of the frozen shelf life of the food. There is no reason why a temperature recorder could not be placed in trucks transporting frozen foods in order to check that the transporters of these foods maintain temperatures of 0°F or below in all parts of the load during shipment. This has been done in some instances. Since, except for fast-food chains, most retailers of frozen foods will not accept the responsibility of determining whether adequately low temperatures are maintained during the shipment of frozen products, it would appear to be up to the producer to require strict transporting specifications and to use only those transporters who follow the required handling procedures.

Handling at Retail

In all probability frozen foods deteriorate to the greatest extent at the retail outlet because of inadequate speed of handling upon arrival, display at temperatures which are not low enough, and neglect of effective rotation of product, i.e., the first item to be offered for sale should be the first item sold. When a carrier arrives at its destination, the driver is eager to unload and move on. However, this should only be done when there is enough help available to promptly move the product to frozen storage. This policy would prevent the storage of frozen foods on outside platforms or inside rooms where the ambient temperatures may be quite high. Storage rooms at retail stores should be held at 0°F or below. In Massachusetts (and possibly other states), it is illegal to hold frozen foods at temperatures higher than 0°F. This law is important for insuring the maintenance of good quality and avoiding any possibility of the development of microbial toxins. Accordingly, a similar law, strictly enforced in all states, would greatly enhance the quality of frozen fish and fish products.

There are three methods of displaying frozen foods at retail, and two of these are inadequate as well as wasteful. Probably the worst of these is the open-shelf unit (Fig. 1). This type of

Figure 2.—Cross section of open-top freezer.



freezer display case also wastes energy since much of the refrigerated air escapes. It also wastes the products that eventually spoil in it. Generally, it is not operated properly, resulting in high temperatures around the product and, in some cases, even defrosting some of the food, and it does not provide for the handling of the food on a "first in, first out" basis.

The open top frozen food display case (Fig. 2) probably provides better temperature for frozen foods than the open-shelf type of frozen food cabinet since cold air is heavier than warm air and tends not to leave the box, but in this instance the frozen product may be piled above the load line, resulting in exposure to high temperatures. Again, there is a defrosting problem with such display cases, and no provision is made for moving the food on a "first in, first out" basis. Some of these cabinets have sliding glass covers, but these are often left open by customers.

Probably the best display freezer in current use for frozen foods is the enclosed shelf-type case having glass-paneled doors (Fig. 3). This type of freezer probably provides fairly good temperatures for frozen foods even though individuals sometimes open the doors and look for what they wish to purchase for several minutes at a time, causing cold air to escape. But even in this type of case there is no provision for handling the product on a "first in, first out" basis. Also, as with the other two types of display cases, both their design and their mode of operation make it impossible to maintain the products at a uniform and relatively constant temperature. Thus, the product is exposed to a broad range of temperatures, depending on its location within the box, and to a large fluctuation of temperatures because of the design which has either a large open side or a large side that is open frequently. Both a broad range of temperatures and fluctuating temperatures contribute to deterioration of quality. These units

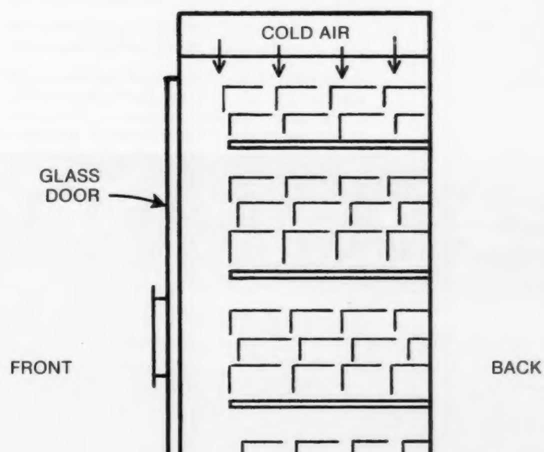


Figure 3.—Cross section of enclosed upright freezer case.

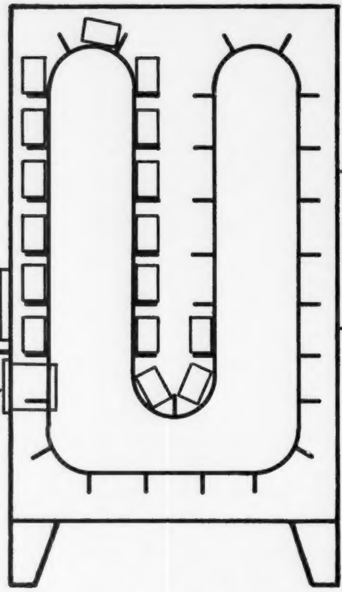


Figure 4.—Conceptual design of frozen seafood dispenser.

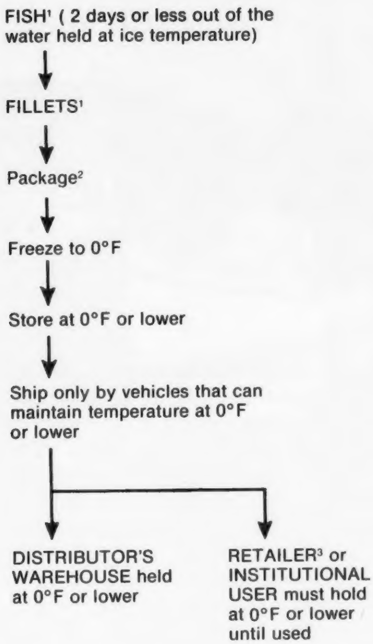
U.S. Grade A fish fillets at the supermarket.

are also plagued with frequent frosting due to the continuing condensing of moisture present in the ambient air which enters the box.

Consideration of these problems has led to the concept of a design which employs principles used in vending machines (Fig. 4). Vending machines are entirely closed, except for small openings that permit the discharge of items therefrom, in single units. This design radically minimizes the exchange of cold air in the machine with the warm ambient air. It further permits an opportunity to effectively insulate the contents from the entry of ambient heat. A thermopane window can be used to permit the customer to view the product.

Vending machines also employ a unit conveyor system that automatically dispenses the first unit loaded into the machine. Thus, for the first time the "first in, first out" principle is relatively assured and the undesirable probability that any of the product might remain in storage for excessively long periods is virtually eliminated. It eliminates problems created by pull-dates due to the customer's selection of those units that have the longest shelf life remaining. This type of freezer case has other advantages which include the virtual elimination of frost accumulation within it and on elements of its refrigeration system because of the inability of moisture-laden ambient air to enter it. Also, since the product will be packaged in gas-impermeable containers, there can be no migration of moisture from the product to any part of the display case.

As with any innovative change in a process, disadvantages of such a display case may emerge when it is tested under commercial conditions. One possibility is that a customer may dispense a package, not like it for some reason, dispense a second or even a third one before being satisfied, leaving the first or second package at ambient temperature, having no way to return it to the machine's conveyor system. This probability can be lowered or perhaps eliminated by insuring uniform apearance and weight among packages. Nevertheless, the advantages to be derived,

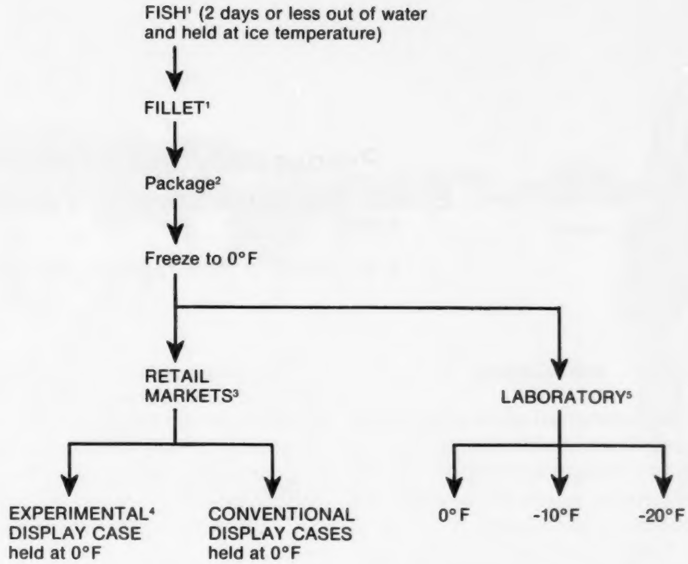


[1]Inspect for quality—use only U.S. Grade A—and during processing

[2]Use gas impermeable and water-vapor impermeable containers

[3]Retailer and other users should be checked for compliance with specified guidelines on handling

Figure 5.—A handling sequence to insure the quality of frozen fish fillets at U.S. Grade A at time of use.



[1]USDC inspected, only U.S. Grade A product to be used

[2]Package to be specified by collaborating packaging engineer

[3]Marketing and economic analysis by collaborating Sea Grant Universities

[4]Experimental display case to be built by collaborating manufacturer. Energy savings and quality protection characteristics of prototype to be compared with those of conventional cases

[5]Storage study in laboratory to determine effect of storage temperature on quality, shelf life, and economics of frozen stored fillets

Figure 6.—Experimental design to test recommended procedures.

especially in conserving energy and preventing spoilage, are expected to outweigh the disadvantages.

Recommended Handling Procedure

Some of the recommendations made herein derive simply from the application of a common sense attitude that should be applied in the handling of all foods. Some of the recommendations may meet with some reluctance, especially where expensive packaging and the use of more refrigeration implies higher costs. However, it is anticipated that the added cost will not be very high and it has already been demonstrated that consumers are prepared to pay the slightly higher price in return for high-quality products. A summary of these recommendations for handling fish fillets is shown in the flow diagram in Figure 5.

An experiment could be designed to demonstrate the ability to maintain the high quality of fish fillets and the technical feasibility of the recommendations. The economics of the recommended procedures can be measured, and these would include a measure of efficacies of specified packaging and the frozen fillet storage/dispenser case shown in Figure 4. A flow diagram of the experimental procedure is shown in Figure 6.

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Productivity and Profitability of South Carolina Shrimp Vessels, 1971-75

T. M. JONES, J. W. HUBBARD, and K. J. ROBERTS

ABSTRACT—This study uses data from a 45-vessel sample of South Carolina's double-rig resident shrimp trawlers to analyze resource productivity and profitability in the fishery from 1971 to 1975. Smaller vessels (<55 feet) were more profitable, and averaged 14 years older than the larger (>55 feet) vessels and had lower operating costs. Placing vessels of both size classes on the same risk and financing-cost basis would result in slightly higher percentage returns, i.e., lower losses, to investment in the larger trawlers than to investment in the smaller trawlers.

An opportunity-cost analysis indicated that shrimping labor is earning less than its opportunity income, as is new capital investment, but that management (the vessel captains) is earning above what it would in its best alternative.

The larger vessels typically possessed about 1.4 times the fishing power of the typical smaller vessels; engine horsepower was the most significant predictor of fishing power. However, multiplication of the vessel fishing power index by the transformed fuel consumption variable (the best proxy for vessel utilization), showed that the average larger vessel exerted only 15 percent more effort in the fishery than did the typical smaller vessel.

Introduction

The commercial shrimp harvesting industry in the South Atlantic States is a fishery thought suitable for regional management within the concept of a state-federal partnership. A profile of the fishery cited stabilized landings, significant increases in license sales and sale of gear, poor prospects for dramatic increases in yields, and a paucity of information on the economic condition of the fishery as characteristics of the region's shrimp industry (Calder et al., 1974). Although the prospect of management to increase the biological yield of shrimp is not encouraging, managers may be able to devise strategies to increase net economic yield (Calder et al., 1974. The increased economic returns from improved management arise from the opportunity to decrease the cost of harvest (Gulland, 1974). While mature shrimp fisheries are not subject to stock overexploitation, excessive costs associated with overcapitalization are possible.

This paper presents a profitability and productivity analysis of the South Carolina shrimp fishery conducted in 1976 with the knowledge that operating units increased significantly in the 1950-71 period with no growth in average catch (Calder et at., 1974). Consequently, the productivity of conventional capital (i.e., nonlabor capital) and human capital (i.e., labor) were estimtated.

The 1971-75 period was selected as the basis for the study. The period includes one high and four aveage years of production. A wide range of ex-vessel prices and increased entry were evident. After a pilot study in the fall of 1975, the data were collected by personal interview in April 1976. Forty-five shrimp vessels were drawn from the population of 271 resident shrimp vessels licensed in 1974. Usable surveys were obtained from 41 vessels. The random sample was stratified on the basis of vessel length, with the dividing point at 55 feet. This classification was suitable due to the fact that engine size increased at that breaking point, and the choice was close to the average vessel size, 53 feet. There were 18 vessels in the 55-feet-and-under class and 23 vessels over 55 feet in length.

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Profitability

The economic condition of the vessels operating in this mature fishery experiencing increased effort was analyzed. In contrast to 1971, which was an outstanding year for shrimp production, for 1972 through 1975 annual production varied only 8 percent from the mean annual production of those years. Thus, the profitability analysis applies to a period of stable total production, the significant diesel fuel price increase of 1974, and generally rising ex-vessel prices. It is an inherent characteristic of fisheries utilization that profits received by current users are often quite different from those experienced by entrants responding to profitability signals. The disparity is in part due to dissimilar cost structures related to the size and age of vessels. In order to depict the signals the fishery can produce, two measures of profitability were estimated.

Profit was initially calculated from sampled vessels' accounting records for the 1971-75 period. The average return to investment and management for the small vessel class over the period was

Typical shrimp vessels.

approximately 38 percent (Table 1). Vessels larger than 55 feet experienced a 4 percent return. Since acceptable estimates of the vessels' market value were not available, these returns refer to original investment. The smaller vessels averaged 23 years old in 1975, compared with 9 years for the larger vessels. The original costs were consequently much lower than they would be if the vessels had been constructed and purchased more recently. In addition, the smaller vessels have less onboard electronics and lower gear costs. These factors lower the original investment in the smaller vessels vis-a-vis the larger vessels. the result is an excellent percentage return on a meager investment even though average profit per vessel actually is quite low.

Table 1.—Average profitability of shrimp vessels in South Carolina for the period 1971-75, by size.

Item	55 feet or less	Over 55 feet
Observations	18	23
Total original investment	$266,267	$1,184,225
Average annual profit[1]	$101,972	$ 47,566
Return to original investment and management	38.3%	4.0%

[1]Computed as gross revenue minus total costs (exclusive of captain's share). This method was utilized because 90 percent of the vessels sampled were owner operated. Captains offered no useful insight as to how management returns are separated from returns to investment.

A prospective entrant to the fishery faces the purchase of a new or used vessel with a cost structure likely different from the average vessel in the fleet. The entrant normally receives a loan for the vessel. As evidenced by the average age of larger vessels, the entrants tend to be larger, more expensive fishing platforms. Captains obtaining financing in South Carolina are required by the lender to purchase hull insurance (Jones[1]). Entrants are then likely to experience higher costs than the vessels sampled, particularly when compared with the smaller vessel class. Vessels in the fishery operating without the expense of hull insurance may appear to earn higher returns. However the returns relate to a higher degree of risk. The operators are simply insuring themselves against loss of the vessel. People contemplating entering the shrimp fishery may not be fully aware of the impact this risk assumption and financing charges can have on net revenues.

[1]Jones, T. M. 1977. A productivity and profitability analysis of the South Carolina double-rig shrimp fishery; A case study of a specialized one year class fishery. Unpubl. Ph.D. Thesis, Clemson University, Clemson, S.C., 121 p.

The second approach to profitability was one involving the placement of all sampled vessels on the same risk and financing basis. Tables 2 and 3 are the derived income statements for the average vessel in each year for small and large vessels, respectively. It must be stressed that these are average costs for firms incurring the particular categories of cost. The impact on returns to investment as compared with Table 1 are dramatic.

Table 2.—Typical income statement for South Carolina shrimp vessels 55 feet or less, 1971-75 and period average.

Item	1971 n=7	1972 n=10	1973 n=12	1974 n=16	1975 n=19	Period average
Variable costs						
Repairs/maintenance	$ 2,047	$ 1,954	$ 2,560	$ 2,127	$ 3,011	$ 2,340
Ice	338	379	465	538	948	550
Fuel/oil	1,337	1,217	2,268	3,036	3,571	2286
Nets	807	924	591	820	1,240	876
Crewshare	5,130	3,633	7,646	4,572	7,602	5,717
Heading/packing	2,789	1,387	1,643	1,469	1,545	1,747
Supplies	1,051	1,317	906	2,015	1,364	1,331
Other	512	260	613	1,107	939	686
Total	14,011	11,071	16,692	15,684	20,220	15,533
Fixed costs						
Insurance	424	437	202	781	1,179	605
Taxes	212	153	169	148	221	181
Interest	294	254	485	796	716	509
Depreciation	1,679	1,707	1,534	1,768	2,097	1,757
Dues	25	25	25	25	26	25
Licenses	120	69	99	84	101	95
Office supplies	430	112	100	53	214	176
Legal/account expenses	186	132	173	210	215	181
Utilities	103	81	114	251	100	131
Other	781	970	1,812	1,549	1,399	1,302
Total	4,254	3,940	4,713	5,665	6,268	4,962
Total, all costs	18,265	15,011	21,405	21,349	26,488	20,495
Total revenue	17,937	12,800	22,437	16,894	26,162	19,246
Net revenue	-328	-2,211	1,032	-4,455	-326	-1,249
Return to original investment and management	-2.6%	-16.7%	7.8%	-32.9%	-2.4%	-9.4%

Table 3.—Typical income statement for South Carolina shrimp vessels over 55 feet, 1971-75 and period average.

Item	1971 n=6	1972 n=9	1973 n=13	1974 n=21	1975 n=21	Period average
Variable costs						
Repairs/maintenance	$ 4,165	$ 3,617	$ 3,963	$ 3,559	$ 3,404	$ 3,741
Ice	727	917	664	501	780	718
Fuel/oil	2,490	3,086	3,629	4,984	5,841	4,006
Nets	593	1,863	1,521	1,320	1,066	1,272
Crewshare	6,746	9,302	12,311	7,787	13,149	9,859
Heading/packing	2,336	1,961	2,403	2,619	2,040	2,682
Supplies	4,325	2,619	2,681	2,885	1,899	2,682
Other	1,201	1,362	1,119	888	1,062	1,124
Total	22,583	24,727	28,291	24,543	29,241	26,084
Fixed costs						
Insurance	1,950	2,302	2,110	2,276	2,512	2,230
Taxes	701	500	272	375	1,343	638
Interest	2,496	2,802	1,791	1,709	1,845	1,929
Depreciation	3,659	4,052	5,088	5,129	4,893	4,564
Dues	25	25	30	30	29	27
Licenses	92	132	130	97	136	118
Office supplies	131	85	85	325	183	162
Legal/account expenses	112	275	359	254	233	247
Utilities	—	—	44	182	86	62
Other	2,622	2,317	1,844	1,830	2,139	2,150
Total	11,788	12,490	11,753	12,207	13,399	12,127
Total, all costs	34,371	37,217	40,044	36,750	42,640	38,211
Total revenue	31,157	30,314	40,586	27,092	44,040	34,638
Net revenue	-3,214	-6,903	542	-9,658	1,400	-3,573
Return to original investment and management	-6.3%	-13.7%	1.1%	-19.0%	2.8%	-6.2%

The conclusion from comparing Table 1 with Tables 2 and 3 is that profits in the South Carolina shrimp fishery for the 1971-75 period accrue primarily to smaller, older vessels and those vessel owners accepting the risk of self insurance. Prospective entrants should, therefore, carefully review the following: 1) Their intentions to purchase a certain size vessel, 2) the availability of equity capital, and 3) the need to increase the days fished on shrimp grounds in other states.

Productivity

The average productivity of labor, capital, and management was estimated for each year throughout the period. This approach was necessary to identify important relationships often obscured by inflation and profitability measures of firms experiencing rising product prices. Vessel productivity in each year of the observed time period was initially determined. Subsequent analysis quantified the labor input annually for 1971 through 1975. All value of production figures were deflated to 1972 dollars and converted to pounds to eliminate the effects of price variations. Table 4 summarizes the findings.

Annual productivities per vessel and per crewman show downward trends during the study period although they were interrupted by an upturn in 1974. One reason for this brief upturn could have been that the exceptionally low prices to producers in 1974 led to more intensive effort to compensate for the low product prices. A backward bending short-run supply curve for effort may exist in the state's shrimp fishery. This circumstance occasionally occurs over short periods when labor is unable to find better employment (Boulding, 1966).

Over the study period the productivity of labor declined 12.7 percent per year. This decrease is substantially larger than that in any of the 17 fisheries studied by Bell and Kinoshita (1973). The South Atlantic shrimp fishery in the Bell and Kinoshita study averaged a 0.7 percent increase in labor productivity between 1950 and 1969. Declining productivity is often

associated with lagging profits, wages, and employment. A disparity between economic and accounting profits among vessels of different sizes was previously outlined. The next section reviews the results of the study in relationship to opportunity wages.

Opportunity Wages

Returns to labor and management were determined from survey information. The average annual crew payment was determined for each firm responding. An examination of crew payment methods showed a consensus as to division of crewshares. On vessels operating with a crew of two, the captain generally received 25 percent of the gross and the striker 15 percent. These figures convert to 62.5 and 37.5 percent, respectively, of the wages paid. Similarly, on a vessel manned by a crew of three, the crewshare is generally 20 percent of the gross for the captain and 10 percent for each striker. This converts to a 50-25-25 percent split of the total wages.

As previously outlined, the crew was classified into management (the captain) and labor (the strikers). The wage analysis was developed by crew size and vessel size (Table 5). The income levels reported are below national and regional averages and established poverty levels. Extenuating circumstances may prevail in some cases. Income may be supplemented by off-season employment income. In addition, the predominance of owner-operated vessels means that many captains have the net boat share to claim. When the net boat share or profit was calculated on an accounting basis, the returns were often positive.

The first employment income comparison was made using the prevailing minimum wage. The \$2.30/hour wage is characteristic of low-skill jobs. While many strikers are proficient, the work ranks among the lower skilled. Daily operations of shrimp vessels commonly range from 10 to 14 hours in the study area. A standard 8-hour day is used as a basis for comparison. The minimum wage would yield daily earnings of \$18.40. The typical striker in no case averaged earning minimum wages for even an 8-hour day. Since South Carolina vessels basically operate on a day-trip basis, the potential value of food and of living on board is too low to change the conclusions.

The primary industry along the South Carolina coast competing for unskilled labor is the pulp and paper industry (Calder et al., 1974). In 1971, the average income for nonfarm laborers was \$4,847 (U.S. Bureau of the Census, 1973). Clearly, strikers in the South Carolina shrimp industry earned below their opportunity returns on a daily work basis.

The captain's share ranged from a high of \$4.13/hour to a low of \$2.86/hour based on the assumption of an 8-hour work day. The highest average seasonal earnings were \$5,914 for a 7-month shrimping season, or the equivalent of \$10,140 on a 12-month basis. This compares favorably with the median yearly income of nonfarm foremen of \$9,057 (U.S. Bureau of the Census, 1973). The comparisons were made with minimum wages and nonfarm labor categories because of the pulp and paper industry demand for labor in the coastal area. According to these comparisons, labor was earning below its local opportunity income, and captains operating their own vessels received income above their opportunity income. Captains owning their vessels also benefit in the long run from appreciation in vessel value.

Fishing Effort

The firm-oriented results of the analysis of South Carolina shrimp vessels previously presented must be viewed along with the industry analysis. An investigation of fishing effort on a vessel and fleet basis was conducted in order to provide additional information. The usual way to examine fishing effort has been to determine the physical factors or inputs that are significantly related to output. These variables determine the fishing power of a vessel. A second component is the time or utilization factor relating to the intensity with which the physical plant is used.

The fishing power or physical plant model included the following physical attributes: Age of vessel, vessel length, beam, draft and horsepower, total net width, and electronic package. These were the independent variables regressed in a linear model against annual landings per sampled vessel. Each vessel class had models for each of the years 1971 through 1975 and one for the entire period. For the smaller vessels, horsepower was significant at the 95 percent level in 1975 and highly significant (99 percent level) for the entire period. For the larger vessels, horsepower was highly significant in 1973, and significant in 1972, 1974, and for the entire period. The all-vessel regression equation for the 1971-75 period was:

$$Y=1939.88 + 104.46X \qquad (1)$$

where: Y=pounds of shrimp landed per time period,
X=engine horsepower of vessel; significant at 95% level;
R^2=0.41, n=40.

Using the information in Equation (1), an effort index was computed in

Table 4.—Firm and labor productivity in the South Carolina shrimp fishery, by years, 1971-75.

Item	1971	1972	1973	1974	1975
			Pounds		
Average productivity per vessel	15,166	11,517	11,142	13,557	8,568
Average productivity per striker[1]	11,598	8,416	7,737	9,464	5,909
			Percent		
Change in vessel productivity from previous year[1]	—	(24.1)	(3.3)	21.7	(36.8)
Change in striker productivity from previous year[2]	—	(27.4)	(8.1)	22.3	(37.6)

[1]Shrimp vessel crewmen are identified as "strikers."
[2]Numbers in parentheses represent negative values.

order to delineate the difference between the two vessel classes. Equation (2) shows the relationship as:

$$E_{ij}=\frac{(HP_{ij})^{0.6964}}{(HP_{\bar{x}j})^{0.6964}} \qquad (2)$$

where: E_{ij}=the physical effort exerted by the jth vessel in the ith class,
HP_{ij}=the horsepower of the jth vessel in the ith class,
$HP_{\bar{x}i}$=the mean horsepower of vessels in the ith class.

The exponent (0.6964) for the general equation is obtained by adjusting the all-vessel period regression coefficient (104.46) from its season-long value to a daily value by assuming 150 fishing days per season. Equations (3) and (4) show the effort indices for the two vessel classes:

$$E_{Sj}=\frac{(HP_{ij})^{0.6964}}{(174)^{0.6964}} \qquad (3)$$

$$E_{Lj}=\frac{(HP_{ij})^{0.6964}}{(273)^{0.6964}}. \qquad (4)$$

A comparison of the relative fishing power of the typical vessel in each of the classes is provided by:

$$\frac{E_{Lj}}{E_{Sj}}=\frac{(273)^{0.6964}}{(174)^{0.6964}}=1.368. \qquad (5)$$

The ratio of these indices indicates that the average vessel in the large class exerts approximately 1.4 times the fishing power of the average vessel in the small class. Application of the physical effort concept could be made to individual vessels as well as to representatives of vessel classes.

A utilization factor shows to what extent the physical plant was utilized. However, measuring utilization is difficult. Log books or other records are only occasionally encountered among vessel operators. Several attributes of the captain (age, education, experience, owner-operator) and his operation (days fished in South Carolina, days fished out-of-state, annual fuel consumption) were considered as possibly relevant utilization factors. In a regression analysis of these factors against annual landings, fuel consumption was significant in each year and vessel class.

Table 5.—Earnings of South Carolina shrimp fishermen, by crew and boat size, 1971-75.

Item	Size of crew: Two	Size of crew: Three	Vessel class: Small	Vessel class: Large
	Number			
Crews observed	21	19	17	23
Avg. days fished	149	194	158	179
	Average seasonal income (dollars)			
Captains	4,214	5,738	3,616	5,914
Strikers	2,541	2,869	2,075	3,156
	Average daily income (dollars)			
Captains	28.28	29.58	22.89	33.04
Strikers	17.05	14.79	13.12	17.63
	Range of average daily incomes (dollars)			
Captains: Low	5.83	4.82	4.82	14.50
High	67.36	60.16	60.16	53.85
Strikers: Low	3.50	2.41	2.41	8.70
High	40.40	30.07	30.07	40.42

The small vessel (6) and large vessel (7) equations for the 1971-75 period are:

$$Y=4259.48 + 1.17\ X_1^{**} \qquad (6)$$
$$R^2=0.58$$

$$Y=2411.12 + 1.19X_1^{**} + 282.16X_2^{*} \qquad (7)$$
$$R^2=0.52$$

where: Y=pounds of shrimp landed per time period,
X_1=gallons of fuel consumed per time period,
X_2=years of experience as a captain.
*=significant at the 95 percent level.
**=significant at the 99 percent level.

Levi and Gianetti (1973) previously found similar values in incorporating fuel consumption in an effort index. To overcome the difficulty of measuring time, and since fuel consumption was a significant variable, fuel consumption was converted to a measure of time. Fuel consumption annually per vessel was adjusted by hourly fuel consumption rates into annual hours of operation. This figure was divided by an assumed 10 hours fishing per day into fuel-equivalent days and was the time proxy variable used in calculating fishing effort. A 10-hour fishing day was used to characterize this predominantly day-trip fishery.

Table 6.—Effect of horsepower and fuel consumption on shrimp production in South Carolina, 1971-75.

Year	Equation[1]	n	R^2
	Small vessels		
1971	$Y = -20{,}967.96 + 195.70X_1 + 9.26X_2$	6	81
1972	$Y = -4{,}259.62 + 52.53X_1 + 12.01X_2^{**}$	9	92
1973	$Y = -6{,}447.82 + 159.46X_1^{**} + 3.84X_2$	10	75
1974	$Y = -10266.30 + 115.15X_1 + 12.69X_2$	13	51
1975	$Y = 6{,}421.95 - 37.32X_1 + 15.21X_2^{**}$	17	83
1971-75	$Y = -1{,}622.96 + 42.75X_1 + 11.64X_2^{*}$	18	64
	Large Vessels		
1971	$Y = 22{,}973.72 - 29.59X_1 + 22.68X_2$	6	36
1972	$Y = -14{,}119.36 + 81.45X_1 + 22.21X_2^{**}$	9	88
1973	$Y = -2{,}094.89 + 66.25X_1^{*} + 9.37X_2^{*}$	13	66
1974	$Y = 7{,}077.72 + 17.32X_1 + 20.59X_2^{**}$	19	64
1975	$Y = 9{,}495.24 - 7.73X_1 + 13.56X_2^{**}$	19	45
1971-75	$Y = 6{,}184.08 + 2.73X_1 + 20.39X_2^{**}$	21	54
	All vessels		
1971	$Y = 8{,}293.71 + 10.60X_1 + 217.11X_2^{*}$	12	61
1972	$Y = -8889.07 + 69.87X_1 + 202.27X_2^{**}$	18	90
1973	$Y = -7087.45 + 133.29X_1^{**} + 100.93X_2^{**}$	23	71
1974	$Y = 3{,}637.35 + 23.13X_1 + 134.56X_2^{**}$	32	58
1975	$Y = 7{,}470.94 - 6.48X_1 + 284.45X_2^{**}$	36	73
1971-75	$Y = 4{,}865.62 + 17.44X_1 + 188.18X_2^{**}$	39	65

Y = Pounds of shrimp landed per time period.
X_1 = Horsepower of vessel.
X_2 = Fuel equivalent days fished per season.
* = Significant at the 95 percent level.
** = Significant at the 99 percent level.

Regression models with horsepower and fuel-equivalent days as independent variables are shown in Table 6 for small, large, and all vessels. Inclusion of the fuel-equivalent days variable with horsepower improved the R^2 and lowered the error of the estimators.

The mathematical expression for total effort can be written as:

$$FE_i = \sum_{j=1}^{n} (E_{ij}) (FD_{ij}), \qquad (8)$$

where: FE_i = the total fishing effort exerted by all vessels in the ith class,

E_{ij} = the fishing power exerted by the jth vessel in the ith class, and

FD_{ij} = the fuel-equivalent days fished by the jth vessel in the ith class.

Equations (9) and (10) show the indices for the two vessel classes aggregated for interclass comparison of fishing effort. These indices represent the period average as being:

$$FE_s = \sum_{j=1}^{18} (E_{Sj}) (FD_{Sj}) = 1{,}962, \qquad (9)$$

and

$$FE_L = \sum_{j=1}^{21} (E_{Lj}) (FD_{Lj}) = 2{,}598. \qquad (10)$$

The class of larger vessels exerted about 32 percent more fishing effort during the 1971-75 period than did the smaller vessels. However, on a per vessel basis, this means that large vessels actually exerted only 15 percent more effort than the average small vessel.

Implications

The implications of the study results are pertinent to firm level decisions and those made on an industry-wide basis by resource managers. The analysis covered a period (1971-75) when annual South Carolina shrimp production varied approximately 8 percent from the mean annual production. Significant fuel price increases and generally rising ex-vessel prices occurred during the period. The population of resident double-rigged shrimpers was stratified as those 55 feet and less in length and those longer than 55 feet.

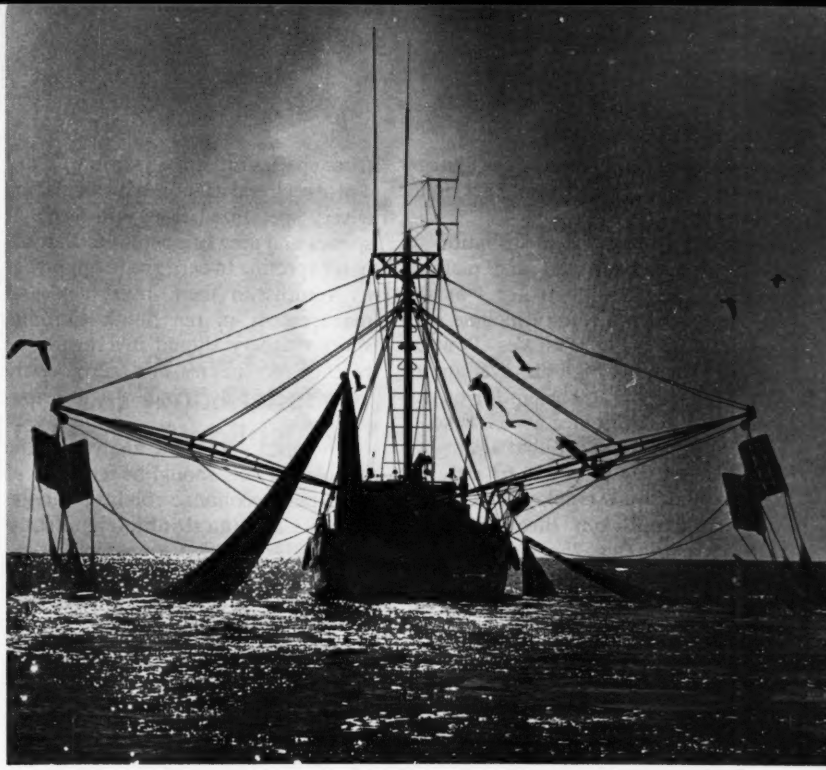
Profitability is one element of an investment decision which must receive major consideration. The analysis points out that vessels in the smaller class earned 38 percent on the original investment as compared with 4 percent for the larger vessels. These profits, it must be recalled, were based on accounting records of sampled vessels.

A further step in the profitability analysis was to put all sampled vessels on the same risk and financing basis. The initial analysis demonstrated that profits on original investment were related primarily to the fact that small vessel owners were operating without hull insurance or interest payments on vessel mortgages. The small vessels averaged 23 years old and the larger vessels 9 years old. Older vessels are frequently unable to get hull insurance and, therefore, operate on a 100 percent owner equity basis.

When all vessels were put on the same risk and financing basis, smaller vessels were projected to experience a negative 9 percent return on investment and larger vessels a negative 6 percent return on investment. These figures reflect the average earnings an entrant would have experienced during the period.

Entrants commonly face mortgage payments by lenders unwilling to make loans without adequate hull insurance. The implication is that prospective entrants may be observing returns on investment of smaller, older vessels carrying considerably more risk than an entrant purchasing a larger vessel with borrowed money from lenders unwilling to accept risks.

It is worth pointing out that, based on the average age of vessels in the two classes, it is obvious that entrants purchase larger vessels. While accounting measures of profit for the period indicate larger vessels earn lower returns, the placement of vessels on a



Shrimping.

common basis reveals that larger vessels experienced lower losses on the average.

In analyzing the distribution of returns among strikers and management, the typical striker was not earning an opportunity income even on an 8-hour day basis. Vessel owners often experience high turnover among strikers. This is a problem for owner-operator and absentee owner alike.

The survey revealed that among the smaller vessels surveyed 63 different individuals were employed in the 49 available positions throughout the 1975 season. This 29 percent turnover rate compares with a turnover rate of 71 percent on the larger vessels. In 1975, 103 different individuals worked in the 60 striker positions on larger vessels.

Prospective investors should be aware that choosing a vessel size may impact labor availability. Turnover may be related to the fact that opportunity incomes are not being earned. However, it appears that the financial aspects of shrimp vessel ownership leave little room to alter the share system in order to shift more income to strikers. Perhaps one opportunity to do so lies in the fact that management, in this sample primarily owner-operators, was earning above opportunity income.

The smaller vessels surveyed infrequently sought shrimp or other species in out-of-state areas. The predominant focus of the effort was in Georgia waters. On the average, less than 10 percent of gross income was realized from out-of-state effort. Although larger vessels exhibited more mobility, the associated income was less than 15 percent of gross income. Both vessel classes infrequently sought income from species other than shrimp. Thus, a prospective entrant is basically facing a very specialized fishery in terms of species and area of operation. Individuals expecting to earn above opportunity returns to their investment and management in the South Carolina shrimp fishery should investigate the role other species and geographic mobility can play in achieving anticipated goals.

The results from the analysis of the sampled vessels should be reflective of the general economic conditions in the South Carolina double-rig shrimp fishery. The resident component of the shrimp industry is almost totally dependent on shrimp revenues and annually anticipate that the shrimp income will come from South Carolina harvests. Concerted efforts to develop supplementary fisheries for other species and manage the region's shrimp resource to encourage mobility are worth investigation for this highly species-and-area-specific fishery.

The analysis revealed that shrimpers reacted to the severe 1974 decrease of ex-vessel prices coinciding with major increases in fuel prices by exerting more fishing effort. This factor resulted in higher vessel and labor productivities in 1974 than those experienced in the excellent market year of 1973. Perhaps this indicates there is not as strong a case for an early season opening or extension of the season in times of economic stress as previously thought.

Bell and Kinoshita (1973) found almost no growth in labor productivity in the South Atlantic shrimp fishery for the period 1950-69. The results of the South Carolina analysis indicate that labor productivity decreased an average of 12.7 percent per year.

An issue raised by the findings of declining labor and vessel productivity, poor returns on investment, less than opportunity earnings of the labor component of the fishery, and no upward trend in landings is the role of the public sector in eliminating these characteristics. While major actions to eliminate the inherent problems are not common in fisheries management, it appears that there are enough signs to make it acceptable to consider declaring the fishery a conditional fishery in relation to National Marine Fisheries Service financial assistance programs. It is imperative to recall before completely endorsing the above idea that in good years the shrimp fishery is likely to be the financial springboard to development of fisheries for supplementary species. The analysis revealed that in spite of much larger size and capital investment, South Carolina vessels in the over-55-feet class exerted only 15 percent more fishing effort than the smaller vessels. Certainly there is significant latent fishing effort among these vessels alone to capitalize on shrimp fishery and underutilized species growth opportunities.

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Survey of the Charter Boat Troll Fishery in North Carolina, 1977

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Introduction

A study of coastal pelagic fishes (king mackerel, *Scomberomorus cavalla*, Spanish mackerel, *S. maculatus*, and bluefish, *Pomatomus saltatrix*) was made in 1977 by the Beaufort Laboratory, Southeast Fisheries Center, National Marine Fisheries Service, to gather catch and effort and biological data from ocean piers and charter boats in North Carolina. The North Carolina research was to be a pilot study to a future survey of all North Carolina, South Carolina, Georgia, and Florida east coast charter boats and piers.

In this paper we: 1) Describe the fishes caught and habitats fished by North Carolina charter boats during 1977; 2) describe the vessels, gear, and methods; 3) present catch and effort data; 4) compare commercial and recreational landings for certain species; and 5) review factors affecting the future of the charter boat fishery.

Saltwater recreational fishing is important socially and economically. A national survey of hunting, fishing, and wildlife-associated recreation showed that approximately 27 million people fished in saltwater in the United States in 1975, generating $3.45 billion in revenue (U.S. Fish and Wildlife Service, 1977). Approximately 22 percent of these anglers engaged in "deep sea" fishing activities. In North Carolina alone during 1966, about half a million resident anglers caught 15 million pounds (6,800 t) of fish (Hayne, 1968). The annual gross expenditures by nonresident recreational fishermen in one coastal community, Morehead City, N.C., exceeded $2.6 million in 1971, nearly $1.4 million of which contributed to personal income (Hart, 1972).

Despite the great importance placed on some fisheries, including coastal pelagics, by Regional Fisheries Management Councils, the extent of recreational catch and effort is unknown. The problems of sampling marine recreational fisheries are many. Most complicating is the diversity of effort; recreational fishermen fish from small private boats, charter boats[1], headboats[2], piers, bridges, and beaches. There are literally thousands of access points along the southeastern U.S. coast. On-site interviews and sampling of all segments of the recreational fishery would require substantial funding and manpower. Unable to sample all parts, we have chosen to study what we feel is obviously a very important segment of the North Carolina saltwater recreational fishery.

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ABSTRACT—North Carolina's 127 charter boats made 7,935 trips trolling for pelagic fishes in 1977. The number of boats fishing for pelagic species varied from 65 to 107 depending on the month. Excluding billfishes, 238,413 fish weighing 1.6 million pounds (726 metric tons) were caught, an average of 30 fish and 198 pounds per trip.

Major species landed by weight were: king mackerel, Scomberomorus cavalla, *737,680 pounds (334.7t); bluefish,* Pomatomus saltatrix, *244,618 pounds (110.0t); dolphin,* Coryphaena hippurus, *174,735 pounds (79.3t); amberjack,* Seriola *spp., 108,998 pounds (49.4t); and wahoo,* Acanthocybium solanderi, *76,324 pounds (34.6t).*

Catch per unit effort varied with season and geographic area and reflected fish migrations. The highest catch rate occurred in October, 4.9 fish per trip, and the lowest in July, 16.3 fish per trip. Boats fishing out of Oregon Inlet and Hatteras Village usually caught a higher percentage of oceanic pelagic species (dolphin, tunas, etc.) and, as a result, had higher mean weights per fish landed.

Fishes and Habitats

The coastal pelagic fish community

[1]A boat for hire which charges on a fixed daily rate regardless of the number of passengers, usually six or less.

[2]Furnishes trips and charges on a per passenger basis for usually 15 to 150 anglers.

consists of species that roam the inshore waters of the South Atlantic Bight (Table 1). These large predators of the community are very important to the recreational and commercial fisheries and include king mackerel, Spanish mackerel, bluefish, and little tunny, *Euthynnus alletteratus*. Coastal pelagic species, both adults and juveniles, migrate south in the fall and winter and north in spring and summer. Spanish and king mackerels spawn offshore, and their young, for the most part, mature there. Bluefish, however, spawn at sea and the juveniles use estuaries as nursery grounds. Costal pelagics occur in the neritic zone, intertidal to the shelf break, and therefore are generally shoreward of the oceanic pelagic species (dolphin, *Coryphaena hippurus*, wahoo, *Acanthocybium solanderi*, tunas, *Thunnus* sp., and billfishes of the genera *Istiophorus*, *Makaira*, and *Tetrapturus*).

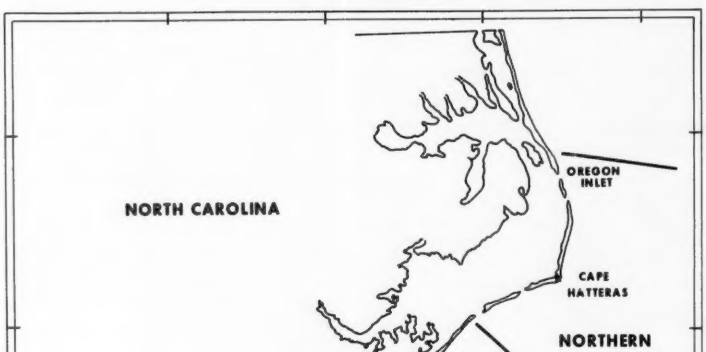
The distribution of oceanic pelagic species is influenced off North Carolina by the Gulf Stream. Gibbs and Collette (1959) referred to the 20°C isotherm as the general preferred minimum low for dolphin in the North Atlantic, and other members of the community tend to stay in warm waters also. As with coastal pelagics, the oceanic species are seasonally abundant. Major species caught by charter boat fishermen are listed in Table 1.

Table 1.—Species of fish generally caught by charter boats trolling in inshore and offshore North Carolina waters.

Common name	Scientific name	Fishing locality
Bluefish	*Pomatomus saltatrix*	Inshore
Greater amberjack[1]	*Seriola dumerili*	Inshore-offshore
Almaco jack[1]	*Seriola rivoliana*	Inshore-offshore
Dolphin	*Coryphaena hippurus*	Offshore
Great barracuda[1]	*Sphyraena barracuda*	Inshore-Offshore
Little tunny	*Euthynnus alletteratus*	Inshore
Atlantic bonito	*Sarda sarda*	Inshore-Offshore
King mackerel	*Scomberomorus cavalla*	Inshore-Offshore
Spanish mackerel	*Scomberomorus maculatus*	Inshore
Wahoo	*Acanthocybium solanderi*	Offshore
Albacore	*Thunnus alalunga*	Inshore-Offshore
Yellowfin tuna	*Thunnus albacares*	Offshore
Blackfin tuna	*Thunnus atlanticus*	Offshore
Bigeye tuna	*Thunnus obesus*	Offshore
Sailfish	*Istiophorus platypterus*	Inshore-Offshore
Blue marlin	*Makaira nigricans*	Offshore
White marlin	*Tetrapturus albidus*	Offshore
Cobia	*Rachycentron canadum*	Inshore

[1]These species are frequently caught over reefs, wrecks, and around buoys, platforms, etc.

Figure 1.—Three geographical areas used in the survey of North Carolina charter boats.



Survey Methods

Charter boats operating from North Carolina ports were surveyed in 1977 by a combination of personal interviews and log book techniques. The coastline was partitioned into three geographic strata: Northern district, Oregon Inlet to Ocracoke; central district, Harker's Island and Morehead City-Atlantic Beach to Sneads Ferry; and southern district, south of Sneads Ferry to South Carolina (Fig. 1). Creel clerks, one for each district, identified the charter boat population and made initial contacts with each operator to familiarize him with the goals and methods of the survey. Forms for recording daily catches were placed on each boat, filled out by the captain or mate, and picked up by the clerk at least weekly. Some boat crews were contacted daily. Many operators failed to keep daily records but provided data for short recall periods (<1 week) to the clerk when ques-

tioned. Data collected for each boat included number of trips, type of trip, date, fishing locality, and number and estimated weight of each species caught. Clerks periodically sampled landings to obtain estimates of mean weight for each species. Species catch and catch per trip data were generated for each district, monthly, by the method outlined in Table 2.

The study was an incomplete census and the estimates obtained are therefore biased. In general, however, we believe the estimates provide a useful description of a fishery which has received little documentation in the past. In retrospect, it is apparent that the three geographical strata should have been partitioned into two vessel classes because distribution of effort in each district was found to be bimodal rather than unimodal. Boats either fished frequently (15-30 trips/month) or fished much less frequently (2-4 trips/month). Also the type of fishing trip varied and included trolling for oceanic pelagics, trolling for coastal pelagics, and bottom fishing. For the 1978 survey, the charter boat fleet will be divided into six strata according to geographical district and frequency of fishing. We intend to obtain as complete coverage as possible of each stratum. We anticipate even greater cooperation from the boat operators in 1978 because of their enthusiastic response to a preliminary copy of this report we furnished them.

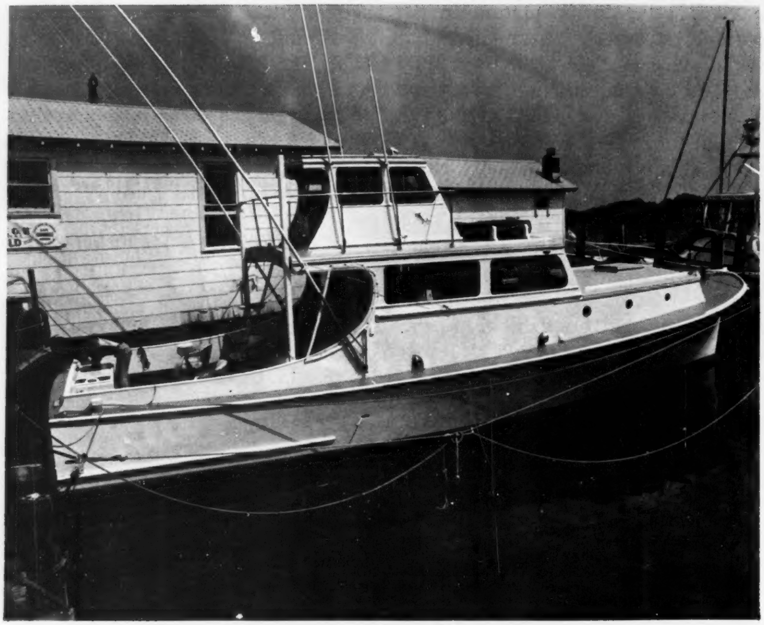
The Charter Boat Fishery

Number of Boats

A total of 127 charter boats operated out of North Carolina ports in 1977; 56 in the northern district, 44 in the

Table 2.—Effort calculations by district, monthly.

District	Trips and records data	April	May	June	July	August	September	October	November	Mean
Northern	A. Total no. boats	52	53	53	53	56	56	56	52	53.9
	B. No. boats fishing	16	32	43	47	51	51	48	40	41.0
	C. Fishing boats reporting	8	23	30	35	37	10	8	8	19.9
	D. No. boats reporting	44	44	39	41	42	15	16	18	32.4
	E. No. trips reported	52	216	347	520	492	165	91	37	240.0 (1,920)
	F. No. trips with catch data	52	152	104	162	251	165	91	37	126.8 (1,014)
	G. No. trips/boat (E/C)	6.5	9.4	11.6	14.9	13.3	16.5	11.4	4.6	11.0
	H. Total no. trips (GxB)	104	301	499	700	678	842	547	184	481.9 (3,855)
	I. Percent trips with catch data (F/H)	50	50	21	23	37	20	17	20	29.8
	J. Percent of fishing boats providing trip data (C/B)	50	72	70	74	73	20	17	20	49.5
Central	A. Total no. boats	44	44	43	43	43	43	43	43	43.3
	B. No. boats fishing	27	29	33	27	30	32	33	32	30.3
	C. Fishing boats reporting	25	25	27	18	11	16	16	12	18.8
	D. No boats reporting	42	40	37	34	24	27	26	23	31.6
	E. No. trips reported	136	210	211	143	61	219	270	201	181.4 (1,451)
	F. No. trips with catch data	136	210	211	143	61	219	237	201	177.3 (1,148)
	G. No. trips/boat (E/C)	5.4	8.4	7.8	7.9	5.5	13.7	16.9	16.8	10.3
	H. Total no. trips (GxB)	147	244	257	213	165	438	558	538	320.0 (2,560)
	I. Percent trips with catch data (F/H)	93	86	82	67	37	50	42	37	61.8
	J. Percent of fishing boats providing trip data (C/B)	93	86	82	69	37	50	48	38	62.9
Southern	A. Total no. boats	27	27	26	27	27	27	27	27	26.9
	B. No. boats fishing	22	25	25	21	20	24	26	22	23.1
	C. Fishing boats reporting	10	13	14	9	5	10	10	9	10.0
	D. No boats reporting	15	15	15	15	12	13	11	14	13.8
	E. No. trips reported	76	140	114	50	14	112	119	52	84.6 (677)
	F. No. trips with catch data	76	140	114	42	14	112	119	52	83.6 (669)
	G. No. trips/boat (E/C)	7.6	10.8	8.1	5.6	2.8	11.2	11.9	5.8	8.0
	H. Total no. trips (GxB)	167	270	203	118	56	269	309	128	190.0 (1,520)
	I. Percent trips with catch data (F/H)	46	52	56	36	25	42	39	41	42.1
	J. Percent of fishing boats providing trip data (C/B)	45	52	56	43	25	42	38	41	42.8
Boats actually fishing (ΣB)		65	86	101	95	101	107	107	94	94.4 (755)
Total boats (ΣA)		123	124	122	123	126	126	126	122	124.0 (992)
Percent of fleet fishing $\frac{(\Sigma B)}{(\Sigma A)}$		52.8	69.4	82.8	76.4	80.2	84.9	84.9	77.0	76.1



Charter boat, Morehead City, N.C.

central, and 27 in the southern. The number of boats remained fairly stable within each district for the season. The percentage of the fleet actively fishing varied monthly, averaging 76 percent. Boats were least active in April (53 percent fished) and most active in September and October when 85 percent of the boats made trolling trips (Table 2). Reasons for not fishing included inclement weather, equipment failure, and lack of customers.

Vessels and Equipment

Boats ranged in length from 29 to 55 feet ($\bar{X}$=32), were primarily wooden hulled, although a few are fiberglass, and ranged in age from 0 to 44 years ($\bar{X}$=16). Approximately 60 percent of the boats had a single diesel engine, and about one-fourth of the vessels had twin diesel engines. Speed varied from about 10 to 25 mph (Charles Manooch, pers. obs.). Basic equipment included radios (CB and VHF) and fathometer. More than half of the charter boats had loran, usually loran-A, but some were in the process of changing to loran-C (Abbas, in press).

Fishing tackle used depended on the type of fishing: Larger gear (9/0-16/0 reels and 80-130 pound test line) for oceanic species and smaller gear (4/0-6/0 reels and 40 pound line) for bluefish and mackerels. Lines with spoons, feathered jigs, etc., are trolled behind the boat at the surface or at various depths using weights or planers. Strips of squid or fish are often placed on the hook(s) of artificial lures. Trolling is usually conducted in an almost random fashion until a fish is hooked, and then the boat circles in the same area until the catch rate becomes unsatisfactory.

Trip Types

Trips are either half-day or full-day but, like Abbas, we found that a very few half-day trips were made. Therefore, we standardized trips on a full-day basis.

Fishing Areas

Boats fishing offshore troll in the Gulf Stream (12 miles offshore at Hatteras to 50 miles at Southport) or around natural reef areas just shoreward of the stream. On a full-day trip, boats generally leave before sunrise and return to the docks around 1500 hours. Inshore fishing is around inlets, just outside the surf zone, and in the vicinity of wrecks, and artificial and natural reefs. Captains are aided in their search for pelagic species by fathometers and also by the presence of birds feeding on forage fish which have been injured or forced near the water's surface by predation from below.

Results

Charter boats made 7,935 trolling trips in 1977 and excluding billfishes, caught 238,413 fish weighing 1,568,108 pounds. The average trip produced 30 fish which weighed 198 pounds (Table 3). Catch by species and catch per unit effort data were stratified by district, monthly (Tables 4, 5, 6) and will be discussed below.

Species Composition of Landings

Charter boat anglers caught 18 species of fish by trolling baits (Table 1). The five most frequently caught species by number and weight were: King mackerel, 87,478 and 737,680 pounds; bluefish, 67,262 and 244,618 pounds; dolphin 22,146 and 174,735 pounds; amberjack *Seriola* spp., 6,540 and 108,998 pounds; and wahoo 3,062 and 76,324 pounds (Table 3). Fishermen also caught 35,375 Spanish mackerel which weighed 49,739 pounds. An average 11.0 king mackerel were caught per trip, 8.5 bluefish, 4.5 Spanish mackerel, and 2.8 dolphin. These four species represented 89 percent of the fish landed on a daily average basis.

King mackerel and bluefish were caught each month of the fishing season, but others, specifically cobia, *Rachycentron canadum,* albacore, *Thunnus alalunga,* and bigeye tuna,

Table 3.—Total catch and catch per unit effort made by North Carolina charter boats trolling in 1977, by month.

Species		April	May	June	July	August	September	October	November	Total
	Trips	418	815	959	1,031	899	1,549	1,414	850	7,935
King mackerel	No.	10.995	20.425	7.544	1,052	1.038	16.116	19.544	10.764	87.478
	Wt.	62.165	102.987	53.402	10.066	10.594	154.016	208.038	136.412	737.680
	No./trip	26.3	25.1	7.9	1.0	1.2	10.4	13.8	12.7	11.0
Spanish mackerel	No.	—	1.047	2,088	3.305	1.673	15.225	11,450	587	35.375
	Wt.	—	1.102	2,071	4,009	2.169	22.202	17.439	747	49.739
	No./trip	—	1.3	2.2	3.2	1.9	9.8	8.1	0.7	4.5
Bluefish	No.	3.039	1,010	3.855	5.510	9.934	11.099	24.547	8.268	67.262
	Wt.	25.585	8.214	8.452	9.875	11,931	21.191	89.614	69.756	244.618
	No./trip	7.3	1.2	4.0	5.3	11.1	7.2	17.4	9.7	8.5
Dolphin	No.	126	1.591	6,716	5.078	2,645	4.520	1.358	112	22,146
	Wt.	2,107	13,977	56.342	36.893	16,981	36.686	10,720	1,029	174,735
	No./trip	0.3	2.0	7.0	4.9	2.9	2.9	1.0	0.1	2.8
Wahoo	No.	27	147	328	554	997	668	296	45	3,062
	Wt.	955	3.568	6.588	14,524	28.579	13,775	7,260	1,075	76,324
	No/trip	0.1	0.2	0.3	0.5	1.1	0.4	0.2	0.1	0.4
Little tunny	No.	692	435	27	121	240	1,865	2,293	1,247	6,920
	Wt.	5,441	3,720	266	961	2,159	16,734	19,967	9,705	58,953
	No./trip	1.7	0.5	<0.1	0.1	0.3	1.2	1.6	1.5	0.9
Yellowfin tuna	No.	14	88	43	63	47	540	71	2	868
	Wt.	490	2,460	1,685	1,407	1,659	20.081	2,315	100	30.197
	No./trip	<0.1	0.1	<0.1	0.1	0.1	0.3	0.1	<0.1	0.1
Blackfin tuna	No.	131	532	11	126	129	1,842	2,062	—	4,833
	Wt.	1,044	3,917	135	1,260	1,213	22,915	27,012	—	57,496
	No./trip	0.3	0.7	<0.1	0.1	0.1	1.2	1.5	—	0.6
Bigeye tuna	No.	—	14	—	238	359	3	—	—	614
	Wt.	—	221	—	238	431	30	—	—	920
	No./trip	—	<0.1	—	0.2	0.4	<0.1	—	—	0.1
Atlantic bonito	No.	64	164	137	186	427	253	618	—	1,849
	Wt.	285	1,203	841	942	3,328	1,898	4,845	—	13,342
	No./trip	0.2	0.2	0.1	0.2	0.5	0.2	0.4	—	0.2
Albacore	No.	—	—	—	—	81	—	—	—	81
	Wt.	—	—	—	—	518	—	—	—	518
	No./trip	—	—	—	—	0.1	—	—	—	<0.1
Amberjack	No.	136	489	376	341	374	2,342	1,068	1,414	6,540
	Wt.	2,919	8,661	7,598	6,672	5,737	37,784	18,613	21,014	108,998
	No./trip	0.3	0.6	0.4	0.3	0.4	1.5	0.8	1.7	0.8
Barracuda	No.	—	10	25	270	118	680	213	48	1,364
	Wt.	—	98	220	2,720	1,503	7,117	2,007	357	14,022
	No./trip	—	<0.1	<0.1	0.3	0.1	0.4	0.2	0.1	0.2
Cobia	No.	—	3	17	1	—	—	—	—	21
	Wt.	—	167	352	47	—	—	—	—	566
	No./trip	—	<0.1	<0.1	<0.1	—	—	—	—	<0.1
Totals	No.	15,224	25,955	21,167	16,845	18,062	55,153	63,520	22,487	238,413
	Wt.	100,991	150,295	137,952	89,614	86,802	354,429	407,830	240,195	1,568,108
	No./trip	36.4	31.8	22.1	16.3	20.1	35.6	44.9	26.5	30.0
	Wt./trip	241.6	184.4	143.8	86.9	96.6	228.8	288.4	282.6	197.6

T. obesus, were caught infrequently (Table 3).

Seasonality of Landings

The availability of pelagic species to the charter boat fishery is influenced by spring and fall migrations. The offshore, Gulf Stream, fishing area has more stable water temperature. Even there, however, pelagic species are only seasonally abundant.

Fishing trips reflect these seasonal migrations and more trips were made during September and October than any other months. Indeed, 48 percent of all trips occurred from September through November (Table 3). Recreational effort declined in November as vessel operations shifted to commercial fishing, principally for king mackerel. The decline in effort did not, therefore, indicate a decrease in availability. While the catch rate was generally good in the spring—April and May—relatively few trips were made because of bad weather and also many boats were just "gearing up" for the fishing season. Catch rates reflect migrations, and the highest catch rate was recorded in October, 44.9 fish per trip, followed

Table 4.—Catch and catch-per-unit effort made by charter boats trolling in the northern district by month, 1977.

Species		April	May	June	July	August	September	October	November	Total
	Trips	104	301	499	700	678	842	547	184	3,855
King mackerel	No.	2,511	8,045	3,393	119	319	8,252	9,211	3,088	34,938
	Wt.	13,119	46,805	24,090	1,714	4,179	79,632	105,005	40,762	315,306
	No./trip	24.1	26.7	6.8	0.2	0.5	9.8	16.8	16.8	9.1
Spanish mackerel	No.	—	—	—	84	163	2,627	2,407	—	5,281
	Wt.	—	—	—	101	261	4,203	3,731	—	8,296
	No./trip	—	—	—	0.1	0.2	3.1	4.4	—	1.4
Bluefish	No.	878	837	3,743	5,460	9,926	1,431	5,744	2,585	30,604
	Wt.	7,041	6,890	7,523	9,828	11,911	5,753	48,250	24,041	121,237
	No./trip	8.4	2.8	7.5	7.8	14.6	1.7	10.5	14.0	7.9
Dolphin	No.	80	1,204	4,221	3,780	2,583	4,126	1,258	50	17,302
	Wt.	1,600	9,229	32,924	28,350	16,531	33,586	10,026	350	132,596
	No./trip	0.8	4.0	8.5	5.4	3.8	4.9	2.3	0.3	4.5
Wahoo	No.	—	84	250	476	956	632	284	40	2,722
	Wt.	—	1,532	4,900	13,185	27,628	12,766	6,978	1,000	67,989
	No./trip	—	0.3	0.5	0.7	1.4	0.8	0.5	0.2	0.7
Little tunny	No.	—	58	—	35	108	1,288	1,400	99	2,988
	Wt.	—	467	—	231	799	12,455	13,608	728	28,288
	No./trip	—	0.2	—	<0.1	0.2	1.5	2.6	0.5	0.8
Yellowfin tuna	No.	—	59	15	56	34	539	71	—	774
	Wt.	—	1,427	626	1,198	1,061	20,051	2,315	—	26,678
	No./trip	—	0.2	<0.1	0.1	<0.1	0.6	0.1	—	0.2
Blackfin tuna	No.	131	526	10	126	129	1,726	2,062	—	4,710
	Wt.	1,044	3,832	120	1,260	1,213	21,523	27,012	—	56,004
	No./trip	1.3	1.7	<0.1	0.2	0.2	2.0	3.8	—	1.2
Bigeye tuna	No.	—	3	—	238	359	—	—	—	600
	Wt.	—	67	—	238	431	—	—	—	736
	No./trip	—	<0.1	—	0.3	0.5	—	—	—	0.2
Atlantic bonito	No.	—	20	5	182	373	253	602	—	1,435
	Wt.	—	112	45	910	2,648	1,898	4,696	—	10,309
	No./trip	—	0.1	<0.1	0.3	0.6	0.3	1.1	—	0.4
Albacore	No.	—	—	—	—	81	—	—	—	81
	Wt.	—	—	—	—	518	—	—	—	518
	No./trip	—	—	—	—	0.1	—	—	—	<0.1
Amberjack	No.	5	21	100	126	27	160	372	29	840
	Wt.	150	323	2,460	2,344	567	4,800	7,440	725	18,809
	Wt./trip	<0.1	0.1	0.2	0.2	<0.1	0.2	0.7	0.2	0.2
Barracuda	No.	—	—	—	42	34	109	98	6	289
	Wt.	—	—	—	533	615	1,240	980	48	3,416
	Wt./trip	—	—	—	0.1	<0.1	0.1	0.2	<0.1	0.1
Cobia	No.	—	3	15	—	—	—	—	—	18
	Wt.	—	167	326	—	—	—	—	—	493
	No./trip	—	<0.1	<0.1	—	—	—	—	—	<0.1
Totals:	No.	3,605	10,860	11,752	10,724	15,092	21,143	23,509	5,897	102,582
	Wt.	22,954	70,851	73,014	59,892	68,362	197,907	230,041	67,654	790,675
	No./trip	34.7	36.1	23.6	15.3	22.3	25.1	43.0	32.0	26.6
	Wt./trip	220.7	235.4	146.3	85.56	100.8	235.0	420.6	368.0	205.1
Blue marlin[1]	No.	—	2	12	19	14	24	2	0	73
White marlin[1]	No.	—	5	40	70	55	152	9	0	331
Sailfish[1]	No.	—	2	4	5	30	7	0	0	48
Bluefin tuna[1]	No.	—	—	7	—	—	—	—	—	7

[1] These species were not expanded and not included in total No., Wt., No./trip, or Wt./trip calculations.

Table 5.—Catch and catch-per-unit effort made by charter boats trolling in the central district by month, 1977.

Species		April	May	June	July	August	September	October	November	Totals
	Trips	147	244	257	213	165	438	558	538	2,560
King mackerel	No.	2,539	2,741	1,309	388	462	2,718	4,240	5,385	19,782
	Wt.	18,132	19,667	10,555	3,610	4,976	22,152	41,128	71,136	191,356
	No./trip	17.3	11.2	5.1	1.8	2.8	6.2	7.6	10.0	7.7
Spanish mackerel	No.	—	1,047	2,035	2,263	1,320	10,556	5,456	538	23,215
	Wt.	—	1,102	1,981	2,701	1,452	15,834	8,184	673	31,927
	No./trip	—	4.3	7.9	10.6	8.0	24.1	9.8	1.0	9.1
Bluefish	No.	574	154	41	50	8	2,895	15,317	4,288	23,327
	Wt.	4,420	1,172	41	47	20	5,211	35,229	43,260	89,400
	No./trip	3.9	0.6	0.2	0.2	<0.1	6.6	27.4	8.0	9.1
Dolphin	No.	33	209	2,329	1,192	54	225	41	54	4,137
	Wt.	377	2,915	20,679	7,621	410	1,868	365	599	34,834
	No./trip	0.2	0.9	9.1	5.6	0.3	0.5	0.1	0.1	1.6
Wahoo	No.	5	20	66	72	41	17	6	5	232
	Wt.	75	415	1,363	1,204	951	403	162	75	4,648
	No./trip	<0.1	0.1	0.3	0.3	0.2	<0.1	<0.1	<0.1	0.1
Little tunny	No.	582	358	27	47	132	451	738	1,087	3,422
	Wt.	4,671	3,063	266	473	1,360	3,247	5,018	8,457	26,555
	No./trip	4.0	1.5	0.1	0.2	0.8	1.0	1.3	2.0	1.3
Yellowfin tuna	No.	14	29	28	7	13	1	—	2	94
	Wt.	490	1,033	1,059	209	598	30	—	100	3,519
	No./trip	0.1	0.1	0.1	<0.1	0.1	<0.1	—	<0.1	<0.1
Blackfin tuna	No.	—	6	1	—	—	—	—	—	7
	Wt.	—	85	15	—	—	—	—	—	100
	No./trip	—	<0.1	<0.1	—	—	—	—	—	<0.1
Atlantic bonito	No.	64	12	8	4	50	—	16	—	154
	Wt.	285	48	40	32	660	—	149	—	1,214
	No./trip	0.4	<0.1	<0.1	<0.1	0.3	—	<0.1	—	0.1
Amberjack	No.	131	452	254	139	347	1,356	529	1,329	4,537
	Wt.	2,769	8,063	4,779	2,078	5,170	16,679	8,094	19,483	67,115
	No./trip	0.9	1.9	1.0	0.7	2.1	3.1	0.9	2.5	1.8
Barracuda	No.	—	10	25	108	56	267	16	—	482
	Wt.	—	98	220	1,155	577	2,697	149	—	4,896
	No./trip	—	<0.1	0.1	0.5	0.3	0.6	<0.1	—	0.2
Cobia	No.	—	—	2	1	—	—	—	—	3
	Wt.	—	—	26	47	—	—	—	—	73
	No./trip	—	—	<0.1	<0.1	—	—	—	—	<0.1
Totals	No.	3,942	5,038	6,125	4,271	2,483	18,486	26,359	12,688	79,392
	Wt.	31,219	37,661	41,024	19,177	16,174	68,121	98,478	143,783	455,637
	No./trip	26.8	20.7	23.8	20.1	15.0	42.2	47.2	23.6	31.0
	Wt./trip	212.4	154.4	159.6	90.0	98.0	155.5	176.5	267.3	178.0

by April, September, and May (Table 3). King mackerel and bluefish catches peaked in spring and fall, and Spanish mackerel were caught more frequently in the fall.

Gulf Stream trips produced more dolphin and wahoo during the summer. In 1977, dolphin catches peaked in June and wahoo in August (Fig. 2), while in 1961 and 1962 the best catches of dolphin occurred evenly throughout the summer (Rose and Hassler, 1969), and wahoo were more abundant in Oregon Inlet and Hatteras landings in August and September, from 1964 to 1972 (Hogarth, 1976). For Hatteras-Oregon Inlet, from 1964 to 1972, the overall catch rate of wahoo was 0.24 fish per trip (values ranged from 0.02 to 0.68). Our data for the same area revealed an overall catch rate of 0.4 wahoo per trip (monthly values ranged from 0.1 to 1.1). Amberjack and barracuda, two resident species, had relatively stable catch rates throughout the fishing season.

The average size of several species changed seasonally (Fig. 2). Large, "jumbo" or "Hatteras," bluefish (about 8 pounds) were caught in the spring and late fall, and the small, "snapper," bluefish (1-3 pounds) were taken throughout the summer. Small king mackerel (5-6 pounds), locally known as "snakes," were landed in April and May, and the mean size gradually increased to 12.7 pounds in November. During the fall king mackerel fishery, many fish in the 20-40 pound size category were caught off North Carolina.

Geographical Distribution of Landings

The Gulf Stream is much closer to the coastline in the northern district

Table 6.—Catch and catch-per-unit made by charter boats trolling in the southern district by month, 1977.

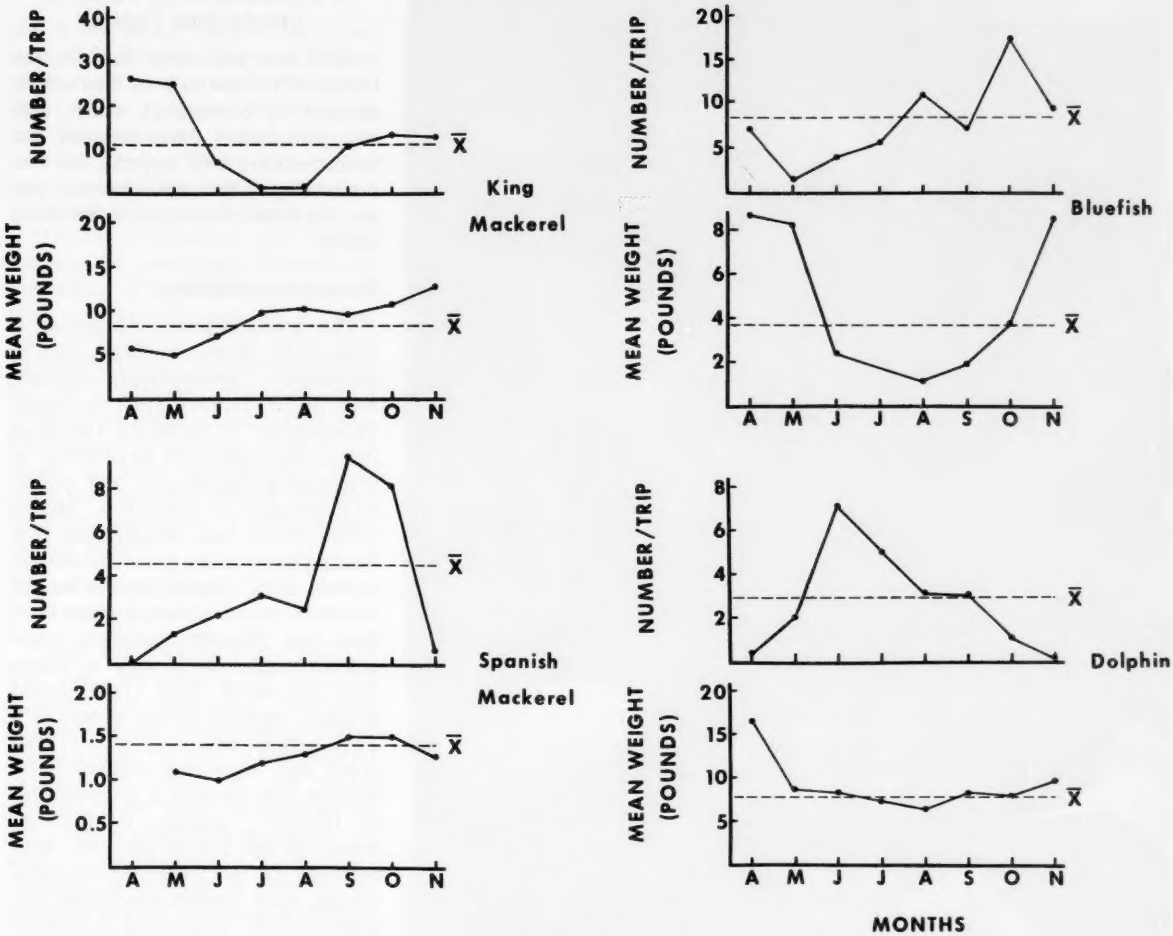
Species		April	May	June	July	August	September	October	November	Totals
	Trips	167	270	203	118	56	269	309	128	1,520
King mackerel	No.	5,945	9,639	2,842	545	257	5,146	6,093	2,291	32,758
	Wt.	30,914	36,515	18,757	4,742	1,439	52,232	61,905	24,514	231,018
	No./trip	35.6	35.7	14.0	4.6	4.6	19.1	19.7	17.9	21.6
Spanish mackerel	No.	—	—	53	958	190	2,042	3,587	49	6,879
	Wt.	—	—	90	1,207	456	2,165	5,524	74	9,516
	No./trip	—	—	0.3	8.1	3.4	7.6	11.6	0.4	4.5
Bluefish	No.	1,587	19	71	—	—	6,773	3,486	1,395	13,331
	Wt.	14,124	152	888	—	—	10,227	6,135	2,455	33,981
	No./trip	9.5	0.1	0.3	—	—	25.2	11.3	10.9	8.8
Dolphin	No.	13	178	166	106	8	169	59	8	707
	Wt.	130	1,833	2,739	922	40	1,232	329	80	7,305
	No./trip	0.1	0.7	0.8	0.9	0.1	0.6	0.2	0.1	0.5
Wahoo	No.	22	43	12	6	—	19	6	—	108
	Wt.	880	1,621	325	135	—	606	120	—	3,687
	No./trip	0.1	0.2	0.1	<0.1	—	0.1	<0.1	—	0.1
Little tunny	No.	110	19	—	39	—	126	155	61	510
	Wt.	770	190	—	257	—	1,032	1,341	520	4,110
	No./trip	0.7	0.1	—	0.3	—	0.5	0.5	0.5	0.3
Blackfin tuna	No.	—	—	—	—	—	116	—	—	116
	Wt.	—	—	—	—	—	1,392	—	—	1,392
	No./trip	—	—	—	—	—	0.4	—	—	0.1
Bigeye tuna	No.	—	11	—	—	—	13	—	—	24
	Wt.	—	154	—	—	—	30	—	—	184
	No./trip	—	<0.1	—	—	—	<0.1	—	—	<0.1
Atlantic bonito	No.	—	132	124	—	4	—	—	—	260
	Wt.	—	1,043	756	—	20	—	—	—	1,819
	No./trip	—	0.5	0.6	—	0.1	—	—	—	0.2
Amberjack	No.	—	16	22	76	—	826	167	56	1,163
	Wt.	—	275	359	2,250	—	16,305	3,079	806	23,074
	No./trip	—	0.1	0.1	0.6	—	3.1	0.5	0.4	0.8
Barracuda	No.	—	—	—	120	28	304	99	42	593
	Wt.	—	—	—	1,032	311	3,180	878	309	5,710
	No./trip	—	—	—	1.0	0.5	1.1	0.3	0.3	0.4
Totals	No.	7,677	10,057	3,290	1,850	487	15,534	13,652	3,902	56,449
	Wt.	46,818	41,783	23,914	10,545	2,266	88,401	79,311	28,758	321,796
	No./trip	46.0	37.2	16.2	15.7	8.7	57.7	44.2	30.5	37.1
	Wt./trip	280.3	154.8	117.8	89.4	40.5	328.6	256.7	224.7	211.7

than in the central and southern districts (Fig. 1). This factor has a direct influence on the distribtuion of inshore and offshore effort, and the species composition of local landings. Charter boats fishing out of Hatteras and Oregon Inlet (northern district) fish offshore, in the Gulf Stream, more frequently than do boats from the south. Thus, more oceanic pelagics, such as dolphin, wahoo, and tunas, are landed in the northern ports. Catch per unit effort for dolphin, wahoo, blackfin tuna, *Thunnus atlanticus,* and yellowfin tuna, *T. albacares,* for the three districts, declined from north to south (Tables 4-6). Conversely, catches of coastal pelagic species were generally larger in the central and southern regions of the State (Tables 4-6). As a result of the oceanic versus coastal pelagic catch distribution, the average fish landed in the northern district was larger than the average fish landed in either of the other districts.

Although total effort was not equally divided among districts—3,855 trips in the northern district, 2,560 in the central, and 1,520 in the southern—the average number of trips per boat per month was about the same. Boats in the three regions fished an average of 11.0, 10.3, and 8.0 trips per month (Table 2). Vessels in the southern part of the State generally make bottom fishing trips, which were not included in the effort calculations, while boats at Oregon Inlet and Hatteras do not.

Nontrolling Activities by Charter Boats

Some charter boats not only troll for pelagics, but also make other types of trips such as diving, bottom fishing offshore for reef fish, and bottom fishing in estuaries for cobia and sciaenids. Bottom fishing offshore is the most frequent nontrolling activity. While some charter boats in the central and southern districts advertise bottom fishing, most boats do this only as a secondary choice to trolling. More nontrolling trips were made in the summer when catch rates for pelagic fishes were down. We found (Charles



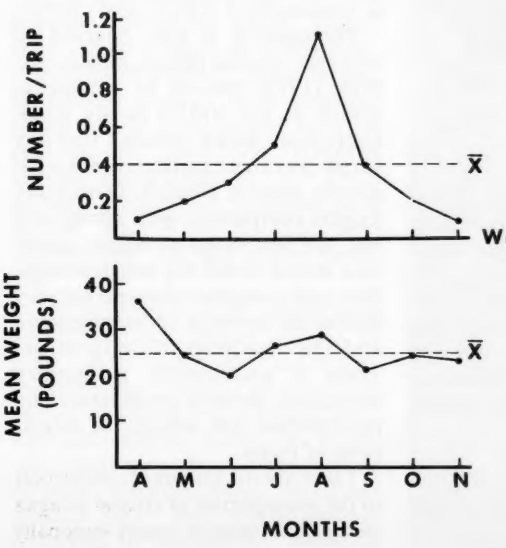
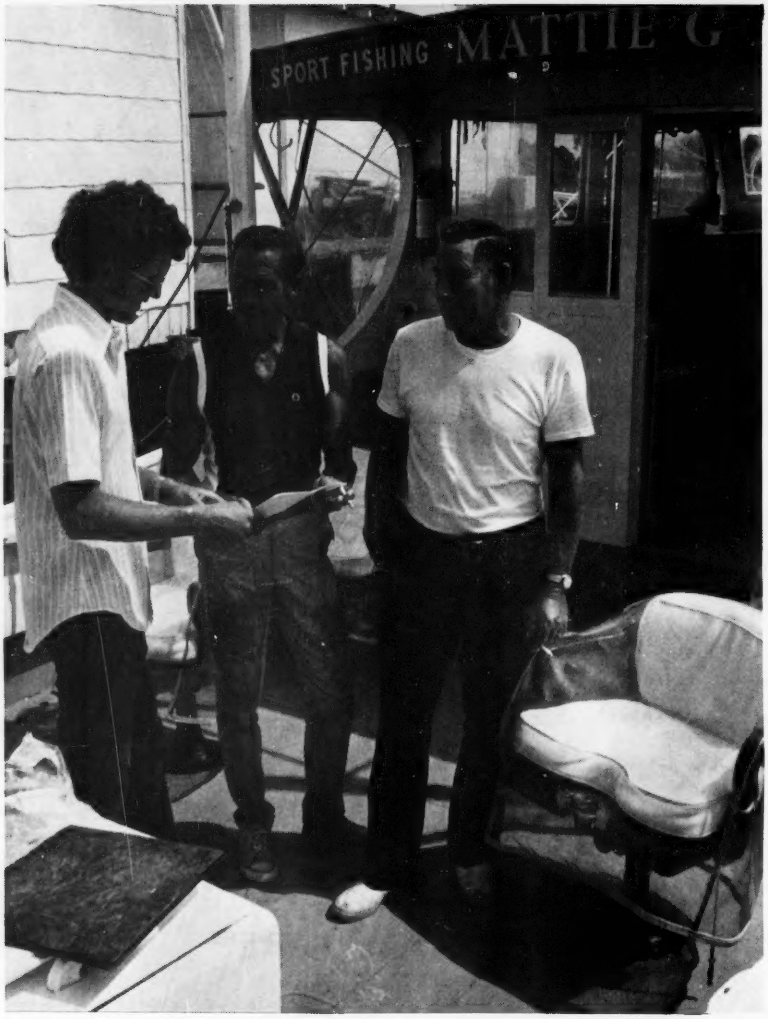


Figure 2.—Monthly catch-per-unit-effort and mean weight of king and Spanish mackerels, bluefish, dolphin and wahoo.



Port sampler with captain and mate discussing catch and effort reporting procedures.

Manooch and Stewart Laws, unpubl. data) that between 8 and 64 percent of the central district charter boats made bottom fishing trips, depending on the month, an average of 4.1 trips for these boats per month, and a total catch of 107,498 pounds. In the southern district, from 22 to 63 percent of the fleet made nontrolling trips, an average of 7.6 bottom fishing trips per boat per month, and landed 64,691 pounds of bottom fishes. A total of 980 nontrolling trips were made by the North Carolina charter boat fleet in 1977 and produced 172,189 pounds (175.7 pounds/trip) of sea bass, *Centropristis,* porgies, *Pagrus* and *Calamus,* snappers, *Rhomboplites* and *Lutjanus,* grunts, *Haemulon,* amberjacks, *Seriola,* and barracuda, *Sphyraena.* This weight represented slightly less than 20 percent of the 1977 North Carolina headboat catch (Huntsman[3], unpubl. data).

A Discussion of the Future of Charter Boat Fishing

As is true with other fisheries, the future of the charter boat fleet will be dictated by economical, social, and biological factors. More precisely, the future status will depend on the availability of fish and fishermen and also the economic net gain achieved by fishing.

Resource Availability

The availability of all species is dictated by abiotic conditions such as temperature, photoperiod, currents, and biotic factors such as food. Temperature is probably the most important physical parameter in determining distribution and migratory patterns of mackerels. Munro (1943) stated that temperature is a limiting factor to the genus *Scomberomorus*; 20°C is reported to be the minimum preferred temperature. Both king and Spanish mackerels make annual migrations to stay in waters 20°C or above. Earll (1883) found Spanish mackerel prefer waters 21°-27°C. Lund and Maltezos (1970) noted that long-range migrations by bluefish were initiated at temperatures of 12°-15°C, whereas local movements, in and out of estuaries, were believed to be triggered by tidal change, local weather conditions, etc. Signs of stress were noted in bluefish at temperatures <12°C and >29°C.

Photoperiod is also believed to influence coastal pelagic migrations. Wilk (1977) referred to behavioral studies at the NMFS Sandy Hook Laboratory which revealed that day length was an important stimulus for activity levels of bluefish. During day lengths comparable with spring and fall, the fish swam at higher speeds than during winter day length settings, thus indicating that photoperiod may initiate the northern spring migration and the southern fall migration. There is undoubtedly a complex interaction between temperature and photoperiod that affects the migrations of fishes.

These abiotic factors are important to the management of coastal pelagics because the resource occurs seasonally

[3]Gene R. Huntsman, NMFS Beaufort Lab., Beaufort, NC 28516.

and is not always available as is true with offshore demersal species. Fishing effort must be exerted during certain times of the year, generally in spring and fall. Unusually bad weather can drastically reduce fishing activity, and unseasonal temperatures can affect migration patterns and timing.

Habitat alterations and fishing activities by man could influence the availability of fishes. Offshore exploration and development of oil and mineral resources could have both detrimental (spills, sediment turbidities, etc.) and beneficial (construction of platforms which attract fish) effects. Overfishing, or reducing stocks to low levels, in other geographical areas could temporarily reduce the catches of migratory species by North Carolina charter boats.

Production of Pelagic Fish Communities

Some fish communities, such as reef fish, are limited by available habitat and restricted, localized production, but the pelagic predator communities are not. Their habitat extends the length of the South Atlantic Bight from shoreline to the shelf break, depending on species, an area of approximately 91,260 km^2. Populations of many of these species are large and will sustain large catches.

Annual productivity may be quite different between the inshore, coastal zone, and the offshore or oceanic zone. Annual production of coastal waters, sandwiched between fertile estuarine waters and the sterile oceanic waters, is relatively low. Odum (1971:51) ranked various ecosystems by their gross primary productivity. Estuaries were highest, 2,000 gC/m^2 per year, open ocean lowest, 100, and coastal zones, 200.

Energy sources to the coastal zone are diversified. Major sources of energy to the coastal zone are migrating organisms, euphotic zone fixation, watershed runoff, and transport from upwelled offshore waters. As migratory stocks move from differing types of areas—estuaries, rivers, coastal and oceanic zones—they utilize seasonal pulsations in productivity. Migrating

Catch of Spanish and king mackerels.

Recording biological information.

The end of a successful fishing trip.

stocks are incorporated into the energy cycle and then break away and emigrate to another area. In some instances the population's new young experience their first year of rapid growth in the systems visited by the parent stock. The impact of these stock movements is immense in terms of energy transfer in and out of local systems by death, waste products, reproduction, and food consumption.

From a managerial standpoint, mobility and the utilization of seasonal energy is important. A species can benefit from one area during a productive period and then move on to another location when conditions become less favorable, i.e., migratory stocks are not restricted to one geographical area for "better or for worse" as are relatively sedentary species.

Biological Characteristics of Pelagic Fishes

The principal biological factors which would influence the fishery are growth, natural mortality rates, and reproductive characteristics. Pelagic species attain their maximum size very rapidly. They are not only fast-growing but are relatively short-lived and experience high annual mortality rates compared with some other groups of fish, again including reef fish. Fishery science has demonstrated that species displaying these characteristics can be fished fairly heavily without overexploitation; stock(s) replenishment is usually rapid.

Coastal pelagic fishes demonstrate reproductive strategies such as high fecundity and protracted spawning, which have definite advantages because eggs and larvae are not as highly susceptible to short-term environmental degradation as for some other species. Also, most pelagic species are not dependent upon estauries as nursery areas. While currents, temperatures, and other naturally occurring conditions can adversely affect spawning and survival of young, man's negative influence is presently minimal on offshore nursery areas. An aspect which may be working to the detriment of the resource is that potential spawners are sometimes removed by fishing before they reproduce for the first time. An example is king mackerel (Beaumariage, 1973).

Competition Among User Groups

North Carolina charter boat operators and commercial fishermen compete for at least four species: king mackerel, Spanish mackerel, bluefish, and cobia (U.S. National Marine Fisheries Service, 1978). Although the charter boat segment of the total recreational catch may range from a low percentage (as with bluefish) to a high percentage (as with dolphin), of the four species caught by commercial fishermen, charter boats alone landed more for two: Three times more pounds of king mackerel, and slightly more Spanish mackerel (49,736 to 46,223 pounds). Commercial landings of bluefish were 9.5 times greater than charter boats because the commercial fishery nets this species, the commercial season lasted a full 12 months, and charter boats place a relatively low priority on bluefish except when large individuals are available. Cobia were relatively insignificant to both fisheries, less than 1,000 pounds for each.

For the development of fish management plans, researchers and managers need to know the total landings for a given species. Commercial data are available, and our survey provides catches for North Carolina charter boats. The recreational landings of tunas, dolphin, and wahoo as listed herein account for most of the recreational catch for these species in North Carolina. Rose and Hassler (1969) estimated that charter boats contributed 96 percent of the North Carolina catch of dolphin; we would assume similarly high percentages for tunas and wahoo.

Coastal pelagics present a problem for total catch analysis, because they may be caught from small private

boats, piers, bridges, and surf. We realize that our survey, although describing a significant recreational fishery, represents a relatively small percentage of the total recreational catch of bluefish, Spanish mackerel, and perhaps king mackerel. We attempted to get some idea of the total catch of these three species by questioning eight fisheries biologists, five from the Beaufort Laboratory and three from the North Carolina Division of Fisheries, Morehead City, N.C. All have worked professionally with recreational fisheries and are avid fishermen. We asked each, independently, to estimate the total recreational catch for the three species, given the 1977 North Carolina charter boat landings. Mean pounds estimated for king mackerel, Spanish mackerel, and bluefish were 1,299,314, 256,089, and 1,613,401, respectively. We plotted these estimates and selected five per species with the least variation between estimates. Average poundages with 95 percent confidence limits were: 1,221,860 (961,760-1,481,690) for king mackerel; 239,636 (219,798-259,474) for Spanish mackerel; and 1,548,664 (1,288,122-1,809,206) for bluefish. We believe these data are the best available for North Carolina for 1977.

These revised estimates indicate the importance of recreational fishing in the State. Recreational fishermen caught 5.0 times more pounds of king mackerel, 5.4 times more pounds of Spanish mackerel, and 0.7 times as many pounds of bluefish as commercial fishermen.

Economics

Abbas (In press) suggested that the average North Carolina charter boat operates in the "red," losing money each year. We suspect that there is a bimodal distribution of the economic returns. A segment of the fleet does quite well financially while another, those boats that fish less often, does not. Although the price of an average trip has increased since 1961 (Rose and Hassler 1969; Abbas, in press), the operating costs have increased drastically. Variable costs, mainly repairs, fuel, mate's salary, and fixed costs, primarily vessel depreciation (Abbas, in press), reduce the net returns to the boat operator-owner. Perhaps the most critical long-term factor affecting the economical status of the fleet is fuel. Not only is fuel expensive, but trolling expends energy at a high rate. Boats are constantly underway going to and from the fishing grounds, searching for fish, and fishing.

Another factor which will continue to influence the fishery is that more people own boats capable of fishing coastal waters, and some are able to fish in the Gulf Stream. The option of chartering a boat may not be as appealing, particularly to North Carolina residents, as in the past. Something is occurring, however, which offsets this because more charter boats are operating than ever before. Since 1961 the number of charter boats has increased from 90 (Rose and Hassler 1969) to 127. A cursory inspection of the ports in March 1978 indicated that more vessels will be operating in 1978. Perhaps the increasing out-of-state tourist trade, which generally does not trailer boats as frequently, is filling the charter fleet demand.

In summary, although costs of fishing are rising, the number of charter boats in North Carolina is increasing and angler success is relatively high. It is difficult to predict the future of the fishery by analyzing data from only 1 year. Perhaps the data presented here will serve as a baseline study and will be expanded in the future to include other geographical areas and segments of the recreational fishery. The subject of recreational catch and effort needs immediate attention for the management of marine fishery resources.

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Moratorium Waiver Conditions Set for Alaska Marine Mammal Harvests

Two Federal agencies have spelled out the conditions under which they will waive a moratorium on the taking of 10 types of marine mammals in Alaska. The moratorium has been in effect on 9 of the 10 mammals since passage of the 1972 Marine Mammal Protection Act. Under newly published regulations, the waiving of the moratorium will take effect when the State revises its own laws and regulations to conform satisfactorily with the Act and the Federal rules. Issuing the new Federal regulations were the U.S. Fish and Wildlife Service, an agency of the Interior Department, and the National Oceanic and Atmospheric Administration, an agency of the Department of Commerce.

Changes in State laws and regulations will be subject to public review and comment before Interior and Commerce give final approval to lifting the present ban. The new Federal regulations, based on scientific evidence, restrict the numbers of animals that may be taken every year. Such taking is consistent with the 1972 Act.

Under the Act, NOAA has responsibility for management of the following affected species: Northern sea lions, harbor seals, largha seals, ringed seals, ribbon seals, Pacific bearded seals, and beluga whales. The FWS is responsible for the polar bear, sea otter, and Pacific walrus. A 1976 waiver on the walrus will be modified by this action.

In 1973, Alaska requested that the Federal moratorium on taking of these animals be waived and that management authority be returned to the State. Following lengthy public hearings on the matter, the presiding administrative law judge issued in 1977 a "recommended decision" finding the State's request to be in accordance with the provisions and policies of the Act. The judge recommended the moratorium be waived, with a limit on the numbers of animals taken annually, and that management be returned to the State.

According to evidence presented at the public hearings, population estimates for the northern sea lion are now 214,000; land-breeding harbor seal, 270,000; largha seal, 200,000-250,000; ringed seal, 1.0-1.5 million; ribbon seal, 90,000-100,000; bearded seal, 300,000-400,000; beluga whales, Cook Inlet stock, 500, and Bering/Chukchi Sea stock, 9,000; polar bear, northern stock, 1,900, and western stock, 3,800; sea otter, 100,000-140,000; and Pacific walrus, 140,000-200,000.

Under the terms of the waiver, there would be an annual taking of up to 6,648 northern sea lions; 10,511 land-breeding harbor seals; 5,700 largha seals; 20,000 ringed seals; 500 ribbon seals; 9,000 bearded seals; 10 Cook Inlet stock and 350 Bering/Chukchi Sea stock beluga whales; polar bears, 55 (northern stock), 115 (western stock); sea otters, 3,000; and Pacific walruses, 3,000.

The decision also grants Alaska the authority requested by the State to take sea lion and harbor seal pups. However, the decision requires that the State establish strict controls in connection with any pup harvest. In a letter to the Governor of Alaska, Richard A. Frank, NOAA Administrator, urged that the State proceed cautiously in determining whether, and if so how, to conduct a pup harvest.

The agencies published simultaneous regulations on the waiver in the 11 January *Federal Register.*

Vessel Seized in Alleged Harpooning of Porpoise

A Mexican fishing vessel has been seized for allegedly harpooning porpoise near Port Isabel, Tex. It was the first seizure of a foreign fishing vessel for violating the Marine Mammal Protection Act of 1972, according to NOAA.

The vessel, *Propemex A-36G,* was seized by the U.S. Coast Guard on 13 December, after a U.S. fishing vessel, the *Divine Command,* complained that persons on board the Mexican ship were harpooning porpoise. The Coast Guard found five dead porpoise on the deck of the *Propemex A-36G* in violation of the Marine Mammal Protection Act.

The seizure came a day after the Mexican ship and a sister fishing vessel, the *Propemex A-1G,* were reported by eyewitnesses as harpooning porpoise. A search of the *Propemex A-1G* by an agent of NOAA's National Marine Fisheries Service, however, turned up no physical evidence of a violation, and subsequently the two Mexican vessels left Port Isabel harbor.

Outstanding Work Cited by NOAA

Six NOAA employees and 33 NOAA units were honored at the NOAA 1978 Awards Luncheon late last year at the Bolling Air Force Officer Club in Washington, D.C.

Winfred H. Meibohm, former Acting Executive Director, NMFS, received NOAA's Program Administration and Mangement Award for his major role in the development of policy supporting the Fishery Conservation and Management Act of 1976, and for his performance as Acting Chief of the Marine Mammal and Endangered Species Division where he laid the foundation for the current favorable progress toward the resolution of the tuna-porpoise problem. He was also

commended for his performance of regular responsibilities.

A joint award for Public Service went to Robert J. C. Burnash, NWS River Forecast Center, Sacramento, Calif., and Arthur F. Gustafson, WSFO, San Franscisco, Calif., for their performance during the 1975-77 California drought. John A. Brown, Jr., National Meteorological Center, NWS, who heads the Development Division, received NOAA's Engineering and Applications Development Award.

For unusually significant contributions to scientific research and development and outstanding contributions to scientific literature, Carleton J. Howard of the Aeronomy Laboratory, Environmental Research Laboratories, was awarded NOAA's Scientific Research and Achievement Award. NOAA's Equal Employment Opportunity Award went to Howard A. Friedman, Tropical Weather Analyst at the National Hurricane Center in Miami, Fla.

A Unit Citation recognizes groups of employees who, through their individual and collective efforts have made substantive contributions to the programs or objectives for which NOAA was established. The cited groups are listed below.

Foreign Fishery Observer Task, Northwest and Alaska Fisheries Center, NMFS: In recognition of having successfully administered all aspects of a many-faceted and highly visible program during the FCMA startup period.

Southeast Inspection Office, NMFS: For the successful assumption of responsibilities for inspections of seafood for DPSC procurement.

Law Enforcement Branch, Fisheries Mangement Division, Northwest Region, NMFS: For dedicated efforts under trying conditions in enforcing fishery regulations in the Pacific Northwest.

National Seafood Quality and Inspection Laboratory, NMFS: For performance in an exemplary manner in carrying out the varied base program of the laboratory.

NOAA ship *Townsend Cromwell:* For superior performance during calendar year 1977 during the five-part cruise which ranged widely from collecting live tuna specimens to providing support to survey teams working the reefs and beaches.

NMFS Operation Fish Flow, 1977: For successful accomplishments during the "fish-flush" operation which involved planning and coordinating the total effort at three Columbia River dams in the indexing of fish.

Other NOAA units cited were: Hydrographic Field Party #1, WSFO Chicago, Flight Edit Program Members, FY 1977; WSFO Cleveland; Budget and Finance Office, PMC; Horizontal Control Party G-19; WSFO Portland; WSFO Boston; Quality Control Branch, Marine Surveys and Maps; WSO Athens; WSO Columbia; NOAA ship Surveyor; Staff of the New York (JFK), WSO; Mesometeorological Program Group of APCL; WSFO Raleigh; WSO Beckley; NOAA ship *Researcher*; WSFO New York; Special Projects Branch, Satellite and Space Support Division; Staff, WSO Bristol; WSFO Fort Worth; Ohio River Forecast Center, Cincinnati; Climate Diagnostics Project; Disaster Preparedness Staff; WSO Huntington; Central Flow Control Facility, ATCSCC; and WSFO Charleston.

DOC Awards Gold and Silver Medals

Twenty-two NOAA employees and two NOAA ships' crews were awarded Department of Commerce gold and silver medals by Secretary of Commerce Juanita Kreps in ceremonies on 23 October. Gold medals, given for contributions of major significance to the Department, the Nation, or the world went to 11 employees; silver medals, for contributions of unusual value, including unusual courage or competence in an emergency, were given to 11 employees and to the crews of the NOAA ships *Heck* and *Rude*.

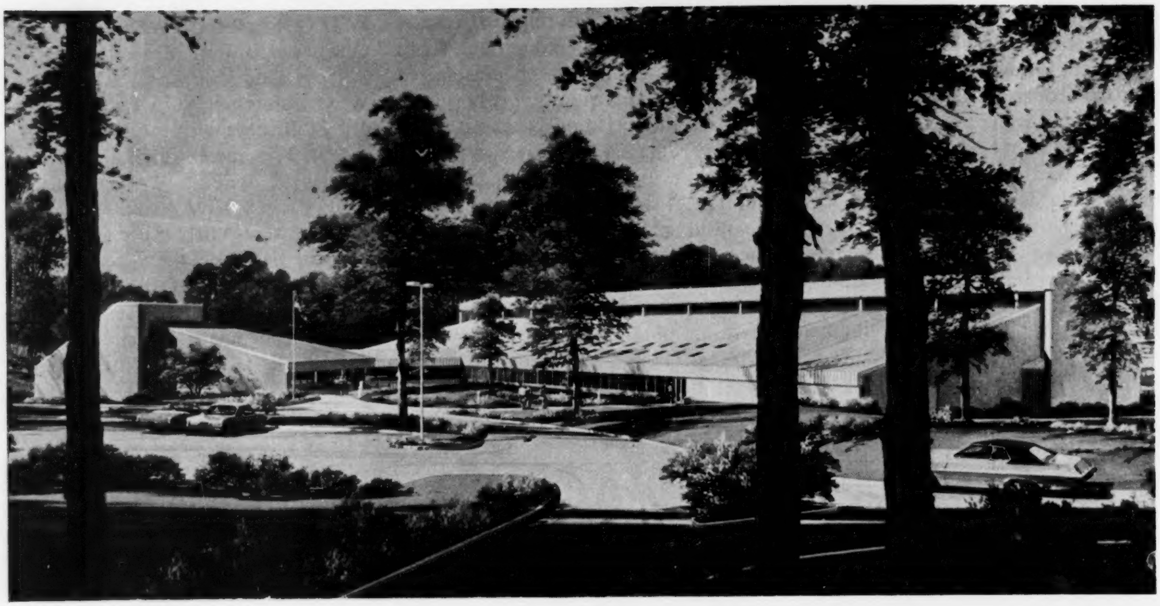
Gold medal winners were: Leonard W. Snellman, Clifton W. Green, and Earl W. Estelle, National Weather Service; Donald Barrick, Michael Evans, and Bob Weber, Environmental Research Laboratories; Norton Strommen, Sharon LeDuc, Clarence Sakamoto, Malcolm Reid, and Augustine Y. M. Yao, Environmental Data and Information Service. Kenneth Sherman, a fishery biologist and Director of the Northeast Fisheries Center's Narragansett Laboratory, received a silver medal for designing and directing a research effort to analyze the consequences of the environmental contamination resulting from the oil spill from the *Argo Merchant* in December 1976. The citation with the silver medal notes the rapid and reliable information produced by Sherman and his team on the effects of the oil on zooplankton and fish eggs, the transmission of the oil through the food chain, and the impact of the oil on future fish populations.

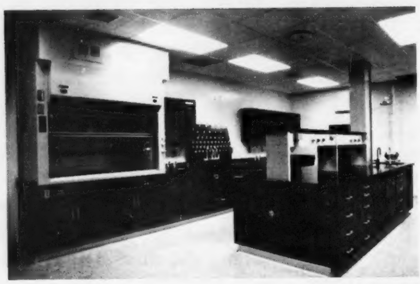
Other silver medalists include: Joe Haskell Allen, EDIS; Harold G. Beard, NGS; Willette M. Carlton, NWS; Robert R. Freeman, ESIC; Leon R. LaPorte, EDIS; Elliott A. Macklow, PA; Ray E. Moses, NOS; Carroll I. Thurlow, NOS; and Philip Williams, Jr., NWS.

Silver medals were awarded to the NOAA ships *Heck* and *Rude* for rescuing the crew and scientists from the burning vessel, MV *Midnight Sun*, and saving the vessel from total loss. The crews actions demonstrated superior performance of duties and exceptional courage in a maritime emergency beyond the call of duty. The incident occurred 7 July 1977 in the Gulf of Mexico, 27 nautical miles from Freeport, Tex.

Serving on the *Heck* were: Thomas W. Ruszala, Charles E. Gross, Mark Aldridge, Horace B. Harris, Charles J. Gentilcore, Dennis S. Brickhouse, Robert T. Linton, Arnold K. Pedersen, Joseph Wiggins, and James P. Taylor.

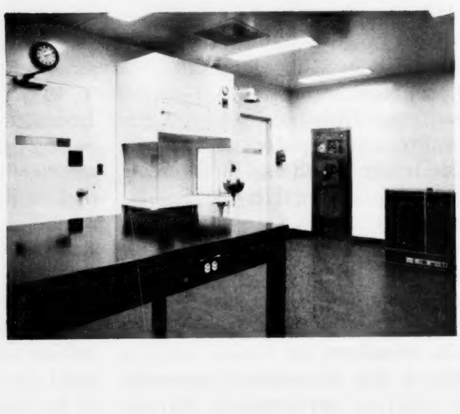
Serving on the *Rude* were: Robert B. Smart, Samuel P. DeBow, Jr., Kenneth G. Vadnais, William N. Brooks, Johnnie B. Davis, James S. Eamons, Kenneth M. Jones, Frank Krusz, Jr., Anthony W. Styron, and Elijah J. Willis.





New NMFS Marine Research Facilities

A new NMFS fisheries utilization and reserach facility, the Charleston Laboratory (top), was dedicated on 31 October at Charleston, S.C. The 45,00-foot^2 complex, part of the Southeast Fisheries Center, will deal with the rational use of fishery stocks, the quality and safety of seafood products, and aquaculture nutrition research. Located at the South Carolina Marine Resources Center, the $3.8 million facility is leased to the Federal Government by the State. Interior views shown include general purpose chemistry laboratory (middle left), project leader offices (middle right), and microbiological research laboratory (bottom). Elsewhere, NOAA has awarded $2.7 million to the Oregon State System of Higher Education for construction of the Newport (Oregon) Aquaculture Laboratory adjacent to the existing Oregon State University Marine Science Center on Yaquina Bay. This 28,000-foot^2 laboratory will provide offices laboratories, and covered and uncovered experimental areas for research and development in marine fish and mollusk genetics, hatchery techniques, nutrition, and disease prevention.



NOAA Opposes Portsmouth, Virginia, Refinery Site

Building an oil refinery in Portsmouth, Va., poses a grave threat to the Chesapeake Bay's $87 million shellfish industry and therefore should not be approved, the Administrator of the National Oceanic and Atmospheric Administration (NOAA) has informed the Chief of Engineers of the Corps of Engineers.

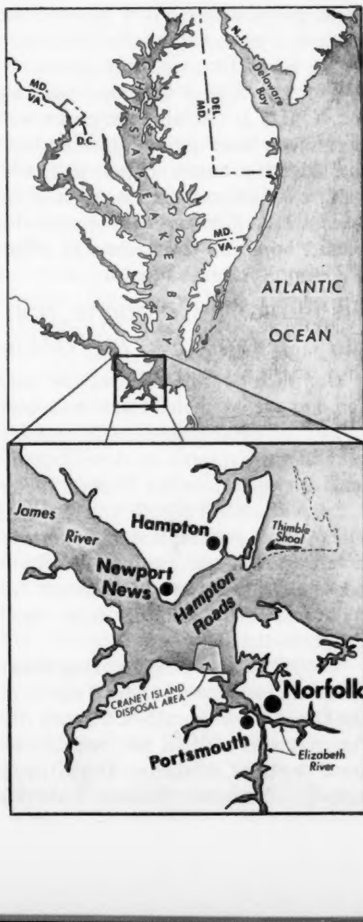
Richard A. Frank, Administrator of NOAA, in a letter to the Chief of Engineers said that an oil spill in the area could have severe adverse effects on the living marine resources, recreational uses, and the related economy of the area. Studies have shown that sediment-bound petroleum in estuarine areas can contaminate the area for more than 10 years. Said Frank, "Construction and operation of the Portsmouth refinery and terminal facilities pose a significant risk of substantial harm, including many lost jobs, to the Maryland and Virginia fishing industries, and thus, to the economies of those States. In my view, on the facts presented, these risks are not justified."

The Corps of Engineers recently announced its intention to issue a permit to the Hampton Roads Energy Company (HRECO) to build a marine terminal and operate a refinery on the Elizabeth River. The refinery is designed to refine 175,000-250,000 barrels of petroleum a day. In addition, the company would be permitted to dredge a tanker and barge approach channel and mooring areas, and to dispose of dredged material at the Craney Island Diked Disposal Area.

In the letter to the Chief of Engineers, accompanied by a 79-page report, Frank indicated that the risks of petroleum spills from the increased number of barges and tankers in the area had not been adequately considered in the decision on the refinery. Frank cited data to show that the accident rate of large tankers, of the size to be used by HRECO to transport both crude and refined products, is more than nine times greater than the overall tanker accident rate for the Hampton Roads area. Moreover, Frank noted, the Hampton Roads accident rate for these larger tankers is more than twice that of tankers of a similar size, worldwide.

Engineering Computer Optecnomics, a consulting firm which analyzed the risks of oil spills for NOAA, projects there probably would be a product barge or tanker accident resulting in the loss of more than 5,000 barrels of petroleum in the area about every 5 years. In the letter, Frank emphasized this is a conservative estimate that does not include a major accident such as a sinking.

Of particular significance is the danger to the blue crabs found in the area. Almost the entire Chesapeake Bay population of adult female blue crabs concentrates during the winter and spring on Thimble Shoals at the mouth of the Bay. These crabs survive the winter by burrowing into the mud, and spawn in the area the following spring. A major oil spill in this area could have significant adverse impacts on the entire Chesapeake Bay population of crabs, as well as the annual $39 million commercial crab industry.



About 50 percent of the total poundage of blue crabs landed in Virginia is caught during the December-March season, and 90 percent of this total is caught in the lower Bay near the Hampton Roads area.

The area also supports an abundance of oysters, clams, and fish that have significant commercial and recreational values. The James River oyster seed beds are a particularly important habitat area, supplying at least three-quarters of the seed oysters in Virginia and a significant portion of Maryland's, as well. These beds could be impaired by an oil spill originating downstream in the Newport News area. Oysters harvested in Chesapeake Bay have an annual value of over $48 million.

If the HRECO refinery is built, Frank said, it is estimated that the volume of petroleum moving through Thimble Shoals would increase as much as 331 percent. Petroleum movements throughout the Hampton Roads and the rest of the Chesapeake Bay and its tributaries are expected to increase by 35 percent over and above the 1975 level.

Another danger cited by Frank is the resuspension of bottom sediments that will occur during dredging operations. Approximately 1.6 million pounds of sediment would be resuspended by the initial dredging. This and maintenance dredging would add to the present problem of low dissolved oxygen levels in the Elizabeth River. Studies have shown that the existing 45-foot deep channel already experiences signs of oxygen depletion during the summer months.

An Interagency Task Force formed by the Chief of Engineers to evaluate

potential sites for refineries indicated that there were 17 sites along the Eastern Seaboard more environmentally sound than the Portsmouth location.

Outstanding NMFS Papers Honored

Awards for the outstanding papers authored by National Marine Fisheries Service scientists and published in the *Fishery Bulletin* and the *Marine Fisheries Review* in 1976 have been presented. Selections were made by the NMFS Publications Policy Board.

James M. Coe, William F. Perrin, and James R. Zweifel received the Outstanding Publication Award for their paper "Growth and reproduction of the spotted porpoise, *Stenella attenuata,* in the offshore eastern tropical Pacific," which appeared in the April issue, 74(2), of the *Fishery Bulletin.* All three authors are with the La Jolla Laboratory, Southwest Fisheries Center, NMFS, La Jolla, Calif.

Elinor M. Ravesi, with the Gloucester Laboratory, Northeast Fisheries Center in Gloucester, Mass., received the Outstanding Publication Award for her paper, "Nitrite additives—harmful or necessary?", published in the April issue of the *Marine Fisheries Review,* 38(4). Honorable Mention Recognition was given Alonzo Pruter for his paper, "Soviet fisheries for bottomfish and herring off the Pacific and Bering Sea Coasts of the United States," published in the December issue of the *Marine Fisheries Review,* 38(12). Pruter is with the Northwest and Alaska Fisheries Center, Seattle, Wash.

Honorable Mention Recognition was also accorded the authors of two *Fishery Bulletin* papers. Receiving this award were Paul Struhsaker and James H. Uchiyama for their paper, "Age and growth of the nehu, *Stolephorus purpureus* (Pisces: Engraulidae), from the Hawaiian Islands as indicated by daily growth increments of sagittae," in the January issue, 74(1). Struhsaker is with the Pascagoula Laboratory, Southeast Fisheries Center, Pascagoula, Miss.; Uchiyama is with the Honolulu Laboratory, Southwest Fisheries Center, Honolulu, Hawaii. James R. Chess and Edmund S. Hobson, both with the Tiburon Laboratory, Southwest Fisheries Center, Tiburon, Calif., also received Honorable Mention for their paper, "Trophic interactions among fishes and zooplankters near shore at Santa Catalina Island, California," published in the July issue, 74(3).

Developed in 1975, the NMFS publications awards program recognizes NMFS employees who have made outstanding contributions to the knowledge and understanding of the resources, processes, and organisms studied as part of the NMFS mission. *Fishery Bulletin* papers must document outstanding, original scientific work while *Marine Fisheries Review* papers must be effective and interpretive in contributing to the understanding and knowledge of NMFS mission-related studies.

Any NMFS employee may recommend publications of the appropriate calendar year to the Publications Policy Board for award consideration. Authors must have been employed by the NMFS at the time the paper was published. Nominations must include the author's name, paper title and number of pages, series name and/or volume, justifications to support the nomination, and the name and office affiliation of the nominator.

Fishermen's Compensation Fund Established by NMFS

Commercial fishermen may be paid for damage to their vessels and gear caused by obstructions resulting from oil and gas exploration, development, and production on the Federal Outer Continental Shelf (OCS), the National Oceanic and Atmospheric Administration (NOAA) has announced. Compensation also may be obtained for economic loss resulting from such property damage.

The Fishermen's Contingency Fund program, established under Title IV of the Outer Continental Shelf Lands Act Amendments of 1978, will be administered by the Commerce Department agency's National Marine Fisheries Service. The Fund is financed by assessing holders of OCS oil and gas leases, permits, and easements or rights of way for pipelines.

Fishermen will not be compensated from the Fund for damages if the owner of the oil and gas related item which caused the damage can be determined, if the damage occurred before 18 September, 1978, or if the fisherman did not file a claim within 60 days after the damage is discovered.

A fisherman's claim is presumed to be valid if the fisherman can establish that: 1) the vessel and gear were being used for commercial fishing and were located in an area affected by OCS activities; 2) the damage and location of the item causing damage were reported within 5 days after discovery; 3) there was no record on nautical charts or in Notices to Mariners on the date the damage occurred that the oil and gas related item causing the damage existed in the area; and 4) the oil and gas related item causing the damage was not marked properly by a surface marker or lighted buoy.

Before regulations to implement the Fishermen's Contingency Fund program were proposed, NOAA's National Marine Fisheries Service initiated a series of public workshops to obtain public comment on certain major issues involved in implementing the program.

Trawlers Get First Sanitation Certificates

Two shrimp trawlers are the first vessels in the U.S. fishing fleet to join NOAA's Sanitary Inspected Fish Establishment Program (SIFE).

Participation in the program means that the two vessels, the *Lady Louise* and the *Brinnie Louise,* meet the sanitation requirements for official seafood processing establishments developed by the National Marine Fisheries Service, Seafood Quality and Inspection Division. The vessels, owned by Mr. and Mrs. Chris Brannon and berthed in Bayou La Batre, Ala., were awarded USDC Approved Sanitation certificates attesting to their sanitation compli-

ance and are listed in the NMFS quarterly publication, *Approved List, Sanitary Inspected Fish Establishments.*

Marine Chemical Waste Dumps Checked by NOAA

A team of scientists with the National Oceanic and Atmospheric Administration (NOAA) is monitoring the dispersion and chemical effects of discharged pharmaceutical waste products in the tropical and Mid-Atlantic Ocean as part of two ocean dumping experiments.

The first demonstration took place 50 nautical miles (80 km) north of Arecibo, Puerto Rico, in late October at the 12,800 foot (4,000 m) depth within the tropical Atlantic. A second experiment began 13 November off the New Jersey coast in 8,000 feet (2,500 m)of water in the Mid-Atlantic Bight.

Until now it has not been possible to trace the dispersion of the largely invisible waste products, the first step in examining their impact upon the marine ecosystem. Scientists from the Commerce Department agency's Atlantic Oceanographic and Meteorological Laboratories in Miami combine acoustical and chemical methods for pursuing the pathways of the dumped material, both vertically and horizontally, in the water column.

Clear liquid wastes, which consist of by-products from the manufacture of drugs such as penicillin, are tracked by a pair of sounding devices towed by the NOAA research vessel *Mt. Mitchell.* The underwater detection system, similar to sonar equipment on submarines, enables scientists to detect and map the dispersion of the waste liquid as it streams from the dumping vessel. At the same time, NOAA researchers take water samples where the acoustic device indicates the highest concentration of dumped liquid.

Results of the demonstrations will show how the chemicals were spread in tropical waters exhibiting very stable conditions and at a site in the temperate zone where the temperature and density of the water vary constantly due to the passage of the Gulf Stream.

Droessler Will Direct NOAA University Affairs

Richard A. Frank, Administrator of the National Oceanic and Atmospheric Administration (NOAA), has announced his intention to designate Earl G. Droessler of North Carolina State University as Director of University Affairs for NOAA. Droessler is Professor of Geosciences and Vice Provost and Dean for Research at the University. The designation, Frank said, has special significance in view of the quality of thought and research available to NOAA from the academic and research communities of the Nation.

Several weeks ago, Frank instructed all elements of NOAA to strengthen their relations with the academic and research communities to better enable the Commerce Department agency to fulfill its mandates in the best possible fashion. NOAA's support of these communities, he said, will in turn strengthen them and permit them to continue to provide outstanding service. Frank said Droessler's extensive background in research and education especially qualified him for the newly created post.

Droessler previously held positions in the Federal government at the Office of Naval Research, the Office of the Secretary of Defense, and the National Science Foundation. Additionally, he has held various academic posts including Professor of Atmospheric Sciences and Vice President for Research and Development at the State University of New York at Albany, where he served prior to joining North Carolina State University in 1971.

A graduate of Loras College and the U.S. Naval Post Graduate School, Droessler was a Fulbright Fellow in meteorology at the University of Oslo. He received an honorary Doctor of Science degree from Loras College in 1958. Droessler began his science career as a meteorological officer in the U.S. Navy during World War II, and then was with the Office of Naval Research and the Office of the Secretary of Defense. In 1958 he joined the National Science Foundation as Head of the Section on Atmospheric Sciences.

In 1963 Droessler became a Visiting Research Fellow at the University of Sydney in Australia, and in 1966 joined the State University of New York. He is a member of a number of professional organizations, including the American Academy of Arts and Sciences, the American Geophysical Union, and the American Meteorological Society, and has chaired a variety of committees in those organizations. Also, he has served on the Boards of numerous other professional and civic organizations.

MARINE POLLUTION OFFICE CREATED

Ferris Webster, Assistant Administrator for Research and Development, NOAA, has established a Marine Pollution Office to serve as focal point for all relevant activities within his area of responsibility.

Headed by R. L. Swanson, the Office reports directly to Webster and exercises line authority over the Marine Ecosystems Analysis (MESA) program, Outer Continental Shelf Assessment program, Hazardous Materials Response program (an outgrowth of the Spilled Oil Research teams), long-term effects research under the ocean dumping act, and NOAA research initiated under the 1978 ocean pollution act.

Swanson, of the NOAA Corps, has headed the New York Bight project of the MESA program for several years, bringing together a varied and diffuse group of research interests to focus on the problems of a body of water heavily impacted by the Hudson and Raritan River outflow and the huge populations of the area. Under his leadership, the citizens, municipal authorities, and governing bodies of the area have been able to focus on the problems of ocean dumping and pollution in what is perhaps the most stressed estuary in the United States.

Cooperating in this effort have been the National Marine Fisheries Service, Sea Grant, the National Ocean Survey, and many others within and outside NOAA.

German and World Dogfish Markets and Catches Reviewed

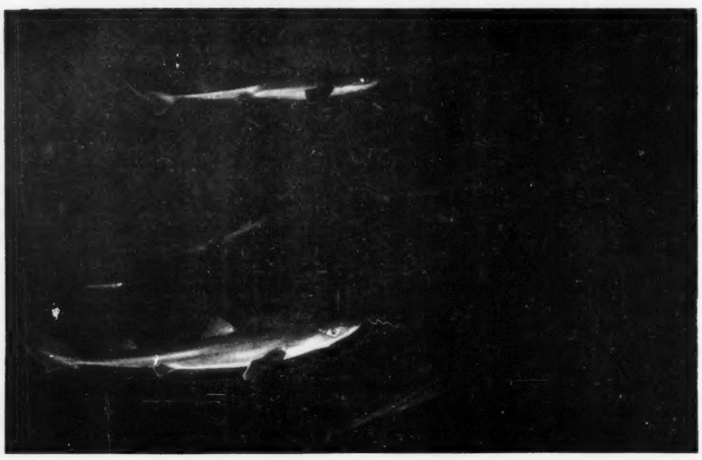
The market for dogfish products in the Federal Republic of Germany (FRG) is fairly static at about 2,000 metric tons (t) per year. Approximately 80 percent of the 2,000 t consists of belly flaps and the remaining 20 percent consists of backs. Since domestic FRG landings supplies of domestic FRG landings of dogfish are estimated at only a few hundred tons per year, practically all supplies of dogfish products are imported. In 1977, Norway supplied about 45 percent of the FRG's dogfish needs, the United Kingdom about 28 percent, the United States about 15 percent, and Canada almost 8 percent. The remaining approximately 4 percent is of unknown origin.

In the first 4 months of 1978, the above pattern of FRG dogfish imports showed significant changes: Purchases from Norway and the Untited Kingdom were nearly halved, while imports from Canada tripled, and Japan and the Republic of South Africa were significant suppliers for the first time with about 6 percent of the import market each. Dogfish of United States origin held its market share at about 16 percent.

Dogfish belly flaps are currently priced at about US$0.90 per pound ($2.00/kg) CIF FRG port of entry. The average weight of the belly flap is about 4 ounces (0.11 kg), and the average length 11 inches (0.32 m); the average width is 3 inches (0.09 m). The flaps are imported deep frozen, polywrapped in wax-lined cartons containing 40-45 pounds (18-20 kg). The CIF price of the dogfish backs is about half of the flap price, or US$0.45 per pound ($1.00/kg). The U.S. Consulate General in Bremen has noted the significant difference between the above CIF prices offered by FRG importers for dogfish products and the average of about US$0.10 per pound ($0.22/kg) paid by U.S. dealers to fishermen for gutted dogfish. In part this is due to the fact that dogfish processing is highly labor-intensive and that the fillet yield is only about one-third of the round weight. About one-fourth of the fillet yield is in flaps and about three-fourths in the lower priced backs, for which there are good markets in France and the United Kingdom. In addition, the Soviet bloc countries, especially the Soviet Union and Poland, are said to be interested in developing dogfish fisheries. The U.S. Consulate General, Bremen, feels that, in light of the wide differential between U.S. ex-vessel and FRG CIF prices for dogfish, U.S. fishermen may want to examine closely the commercial potential of a dogfish fishery for export. It might be possible, for example, to establish a marketing cooperative for the export of dogfish along the lines of the cooperative founded by the North Carolina eel producers. FRG importers have expressed a willingness to provide instruction to U.S. fishermen in processing and quality control standards and to assist them in developing markets for dogfish backs outside of the FRG.

According to the NMFS Office of International Affairs, world dogfish catches have declined in recent years on all major fishing grounds. The FAO Yearbook of Fishery Statistics indicates that world dogfish catches declined from 43,600 t in 1973 to 31,331 t in 1976. More important, the dogfish fisheries in the northeast Pacific (conducted by Canada and Poland) and the northwest Atlantic (conducted

Dogfish. Photo by William High, Northwest and Alaska Fisheries Center, NMFS, NOAA, Seattle, Wash.



The NMFS Division of Foreign Fisheries Analysis, Office of International Fisheries Affairs, has prepared this report based on data supplied by the U.S. Consulate General in Bremen, Federal Republic of Germany (FRG), on the market for dogfish, *Squalus acanthias,* and dogfish products.

by Norway, Poland, Romania, and Canada) have virtually disappeared, leaving only the traditional European fishery in the northeast Atlantic as a major source of supply. As a result, about 96 percent of the world's dogfish catch was taken in the northeast Atlantic in 1976, compared with only 75 percent in 1973. From 1973 to 1976, Norway and the United Kingdom together produced almost 80 percent of Europe's dogfish products (Table 1).

Statistics on trade in dogfish products for other European countries are not available, but the above catch figures suggest strongly that the United Kingdom and Norway were the major suppliers to the principal European dogfish markets other than the FRG. In addition, there are no figures on the total value of international trade in dogfish products, but using the figures in the above text and Table 1, the Division believes that approximately $10 million of dogfish products are produced annually.

In the FRG the flaps are smoked and sold as "See-Aal" and "Schiller-Locken," and all reference to their origin from a shark-like species is avoided. In the United Kingdom, dogfish was called "rock salmon" until a few years ago when the legal nomenclature became "huss."

Finally, in recent years there has been some sporadic concern among consumers, especially in the United Kingdom, over the mercury content of dogfish but this does not appear to be a major problem at present in any of the major European markets. In the FRG, the maximum legal mercury content is one part per million (ppm)[1]. (Source: IFR-78/150.)

Table 1.—Dogfish catches in the northeast Atlantic, by country and quantity, 1973-76.[1]

Country	Catch (t) 1973	1974	1975	1976
Belgium	1,900	1,135	1,037	589
Denmark	2,400	2,141	2,705	1,758
Faroe Isl.	100	0	41	—
FRG	400	316	218	309
Iceland	—	16	10	15
Ireland	—	—	—	17
Netherlands	600	697	342	214
Norway	19,600	17,739	15,447	16,264
Poland	—	—	—	—
Romania	—	—	—	—
Sweden	300	277	236	384
UK (Scotland)	9,200	9,484	10,227	11,179
Total	34,500	31,805	30,266	30,729

[1]Source: FAO, "Yearbook of Fishery Statistics," 1976.

[1]On 25 May 1978 the U.S. Food and Drug Administration (HEW) informed NMFS that they had decided to increase the maximum legal mercury content for certain fishery products from 0.5 ppm to 1.0 ppm.

Note: Unless otherwise credited, material in this section is from either the Foreign Fishery Information releases (FFIR) compiled by Sunee C. Sonu, Foreign Reporting Branch, Fishery Development Division, Southwest Region, National Marine Fisheries Service, NOAA, Terminal Island, CA 90731, or the International Fishery Releases (IFR) or Language Services Daily (LSD) reports produced by the Office of International Fisheries Affairs, National Marine Fisheries Service, NOAA, Washington, DC 20235.

Chilean Abalone Wins Popularity in Japan

Chilean abalone reportedly has established itself as a popular commodity in the Japanese seafood market. Since its first introduction to Japan several years ago, imports of Chilean abalone rose rapidly year after year, from a mere 119 metric tons (t) worth ¥60 million (US$0.3 million at ¥196=US$1) in 1975 to 513 t worth ¥290 million ($1.5 million) in 1976 and to as much as 2,369 t worth ¥1,640 million ($8.4 million) in 1977.

Chilean abalone is being used not only for processing into gourmet food items, but also for serving as "sashimi." Informed sources attribute the success of Chilean abalone chiefly to its price which, at around ¥620-650/kg ($1.44-1.51/lb), is less than half that of Australian abalone.

In contrast to the soaring popularity of Chilean abalone, imports of Australian abalone have declined sharply, namely to 714 t worth ¥1,400 million in 1976 and to 515 t worth ¥950 million in 1977. (Source: FFIR 79-1.)

Japan's South Pacific Skipjack Catch Jumps

The skipjack fishery by three Japanese joint venture firms in the South Pacific was reportedly good for 1978. Combined catches by Solomon Taiyo, New Britain Fishing Industry, and Gollin Kyokuyo for 1978 totaled 48,679 metric tons (t), up 62 percent from the 1977 total of 29,986 t. Solomon Taiyo, based in the Solomons, led the two other firms with a total catch of 18,221 t during 1978, up 84 percent over 1977. Solomon Taiyo's catches between March 1978 and January 1979, totaling 19,010 t, marked an all-time high for the firm. New Britain Fishing Industry came in second with a 1978 total of 16,916 t in waters off Papua New Guinea, up 117 percent form the 7,795 t for 1977, followed by Gollin Kyokuyo, also based in Papua New Guinea, which caught 13,542 t for 1978, up around 10 percent from the 1977 total of 12,313 t. (Source: FFIR 79-2).

NEW ZEALAND AIDS FISHING INDUSTRY

The Government of New Zealand provides substantial incentives to the country's fishing industry. During the 1977-78 fiscal year 1 April 1977 - 31 March 1978) incentives included the following five items: 1) Extension until 31 March 1979 of the provisions allowing the importation of foreign fishing vessels; 2) loans of up to 40 percent of the approved cost of construction of certain New Zealand-built vessels; 3) a fishing vessel ownership savings scheme; 4) loans of up to 80 percent of the value of the vessel, gear, and equipment; and 5) establishment of a fisheries development grant fund with an initial allocation of $205,170[1] (Source: IFR-79/4.)

[1]NZ$200,000 at 30 June 1978 exchange rate of US$1.00=NZ$0.9748.

Peruvian Fishing Law Modified to Attract Investment Capital

The Peruvian Government modified its general fishing law late in 1978 to make private capital investment in the industry more attractive. Decree Law 22329 changes the operation of the "fishing communities" established by the previous Government which allowed workers to participate in company ownership, management, and profits. The new law restricts that participation.

As originally established, employees of Peruvian fishing companies, in addition to receiving individually a certain percentage of the company's profits, also obtained equity in the firm through company payments of a percentage of the profits to the firm's "community of employees." The percentage paid by all fishing companies was 12 percent of the profits. In theory, a firm's "community" accumulated this collective share of profits each year until it eventually held 50 percent of equity in the firm. The workers, through the community, were entitled to vote in the firm's stockholders' meetings and in each firm's board of directors in direct proportion to the community's equity in the firm.

After General Morales Bermudez became the President of Peru in 1975, he adopted a more moderate attitude toward the private sector. Serious lobbying began to modify the "worker community" concept in the fishery and other economic sectors. The above change in the fishing law parallels modifications in the industrial sector which occurred in 1977 and 1978.

These changes include: 1)Workers no longer obtain equity in their companies; instead they will receive preferred stock as part of their share of profits; 2) workers lose their right to participate in stockholders' meetings; 3) the stock is no longer collectively held by the "community"; it is issued to each worker individually; 4) workers are free to sell their shares; and 5) workers, through the community, retain representation on the board of directors, but only up to a maximum of 33 1/3 percent of the board compared with 50 percent under the old law.

The new law also dissolves the "fishing compensation community." This compensation community, which did not exist in the industrial sector, was primarily a scheme for distributing the profits generated by all fishing companies to all the workers in the fishing industry. A certain percentage of each firm's profits entered a central pool. The accumulated funds were then distributed to all fishing companies according to the labor force employed by each firm, and subsequently divided equally among all workers in each firm. Although egalitarian in principle, the compensation community in effect penalized the efficient companies. Moreover, critics complained that the fishing compensation communities had become sluggish bureaucracies, paying their own officials undeservedly high salaries and delaying distribution to the workers.

Initial Peruvian reaction to the new law has been favorable, although somewhat restrained, since the measure had been expected for some time. It is difficult to determine what direct effect this law will have in attracting new investment in the fishing industry. Experience with similar modifications in other industries almost 2 years ago has not demonstrated any dramatic rise in investment. Rather, the reduction of worker participation is seen as a necessary step to promote investment, but may not be sufficient in itself.

Within the fishing sector there had been growing private sector investor interest prior to passage of the new laws. This is due in part to the profit reported by companies processing fish for human consumption and the fact that large investments are not required. While the new law in isolation is not expected to bring about a major shift in investment in Peru, it is viewed positively in Peru as evidence of the Government's desire to create a more favorable climate for private investors.

Other Government actions have helped to restore the confidence of private investors in the fishing industry. In 1976, the Government returned the fleet of anchovy seiners, operated by the state-owned fish meal company (Pesca Peru), to private ownership. While anchovy fishing has been restricted, the Government has authorized the vessel owners to catch sardines, horse and jack mackerel, and other species for reduction. At a meeting held in a suburb of Lima in September 1978, the vessel owners expressed approval of many of the major fishery policies of the Government, especially the reservation of fishery resources to Peruvian fishermen. The Peruvian Government recently declined to renew the agreement with Cuba under which Cuban trawlers were allowed to operate off Peru. Recommendations by the vessel owners, including possible organizational changes in Pesca Peru and Epchap (the state-owned fish meal marketing company) and modifications of the repayment schedules for the anchovy seiners, are under active consideration by the Ministry of Fisheries.

The Government has also decided to return state-owned fishing companies to private ownership. Private investors have purchasd the Challpesa plant in Paita for nearly $3 million. Challpesa was an unsuccessful joint venture between three Japanese companies and the state-owned food fish company Epsep. The Government has also decided to dismantle Epsep and sell most of the company's plants and vessels to private investors. The company reportedly lost nearly $5.0 million in 1976. The Government is also selling 80 percent of Pepesca (Peruana de Pesca, S.A.) which has amassed a debt of over $15 million. (Source: IFR-79/3.)

Tuvalu Sets 200-Mile Economic Zone

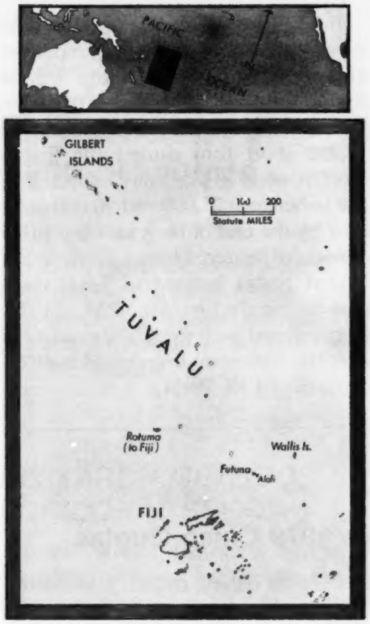
Tuvalu, a cluster of nine atolls northeast of Australia (see map) became independent from the United Kingdom on 1 October 1978. The islands, formerly known as the Ellice Islands, have a population of 9,000. Their total area is only 10 square miles but the nine atolls are scattered over more than 500,000 square miles of the southwest Pacific.

As its first legislative act since independence, the Government of Tuvalu, on 26 October, declared a 200-mile economic zone. The Government declared that, as of 1 January 1979, any foreign-based vessel fishing commercially within the 200-mile zone would require a license from the Ministry of Commerce and Natural Resources. The Government is not aware of any nations presently fishing Tuvalu waters, but knows that U.S. tuna companies have shown an interest in fishing the waters of the South and Central Pacific.

The text of the Government's 200-mile zone proclamation states that fishery limits shall be a "line drawn so that each point thereon is two hundred nautical miles measured from the low-water mark of the seaward side of the reef fronting the coast of any islands in Tuvalu or bounding any lagoon waters adjacent to such coast or, when a reef is not present, from the low-water mark of the coast itself."

In the event that Tuvalu's line intersects a line drawn similarly by any other state or territory, "the fishery limits of Tuvalu shall be a median line or such other line (as may be agreed between the Government of Tuvalu and such state or territory) drawn between the limits of the territorial waters of Tuvalu and the territorial waters of such a state or territory." The proclamation states that Tuvalu will exercise the same exclusive fisheries rights within this limit as it does in its 3-mile territorial waters. Tuvalu's economic zone will intersect those of the Gilberts, Wallis, Futuna, and Fiji.

Tuvalu law provides that any foreign fishing vessel which fishes, loads/unloads fish, or loads/unloads fuel and supplies within the 200-mile economic zone without a license shall be liable on conviction to a fine of $100,000 (US$119,076). Foreign fishing vessels may enter the zone for a "purpose recognized by international law" without a permit, but must return outside the limits as soon as that purpose has been fulfilled and must stow gear or be liable for a $25,000 (US$29,769) fine. Tuvalu law also details the search and seizure powers of authorized officers and sets fines for using explosives and other noxious substances. The Minister is empowered to authorize exemptions for sports fishermen or for scientific investigation. The Minister is also authorized to make regulations for the enforcement of the law as well as for the conservation and commercial development of marine resources. (Source: IFR-79/5.)



Japanese Imports of U.S. and Canadian Salmon Roe May Hit Historical High

Japanese imports of salmon roe, "sujiko" from the United States and Canada totaled 6,533 metric tons (t) during the first 10 months of 1978, and were expected to reach an historical high of about 7,200 t by the end of the year. In spite of the large amount of imports, domestic sales kept pace with shipments and the prices remained stable. This was attributed to the early arrival of shipments by air and the little competition from the domestic fall "sujiko" which was short in production.

The cold storage holdings of salmon roe, reportedly around 2,800 t at the end of October, were predicted to drop to 1,500 t by the end of the year and far below 1,000 t by the end of January. Wholesale prices of imported salmon roe during the yule season of 1978 were reported to be ¥5,700-5,800/kg (US $13.22-13.45/lb at ¥196=US$1) for Grade No. 1 chum salmon roe, and ¥4,500-4,700/kg ($10.44-10.90/lb) for Grade No. 1 pink salmon roe. Estimated imports of U.S. and Canadian salmon roe into Japan during January through November 1978 on a customs clearance basis are given in Table 1. (Source: FFIR 79-1.)

Table 1.—Estimated imports of U.S. and Canadian salmon roe (sujiko) by Japan, January-November, 1978.

Species	Metric tons	Species	Metric tons
Pink	3,220	Silver	330
Red	1,520	King	280
Chum	1,450	Others	50

ROK TUNA VESSELS MAY LEAVE ATLANTIC

South Korean tuna vessels fishing for yellowfin tuna in the Atlantic Ocean are reportedly planning to move to the vicinity of Samoa and Fiji later this year and the next year, where there are already approximately 80 South Korean tuna vessels. The move reportedly would involve most of the around 100 vessels in the Atlantic Ocean which have difficulty in maintaining a profitable operation due to severe fluctuations in prices in Italy, a major buyer of their catches. (Source: FFIR 79-2.)

South Korea, Argentina Lead Fish Block Exports

Japanese exports of frozen fish block suffered a major setback in 1978 due to the steep rise in the value of the yen. Her exports of frozen fish block to the United States to November 1978 only amounted to 2,796 metric tons. (t), less than half of the 6,299 t recorded for the same period in 1977.

On the other hand, Japanese exports of frozen fish fillet to the United States to November 1978 totaled 15,828 t, an amount comparable to the 15,615 t for the same 1977 period, but this reportedly was accomplished by means of cut-rate export prices for the purpose of clearing the inventories. Japanese exports of frozen fish block and fillet, particularly the former were expected to worsen in the future unless the exchange rate of the yen against the U.S. dollar would improve to around ¥220=US$1, according to informed sources in Japan.

In 1978, South Korea and Argentina surpassed Japan as leading exporters of frozen fish block to the United States. South Korean exports of frozen fish block to the United States totaled 12,255 short tons during the first 6 months of 1978 and were expected to rise to between 25,000 and 30,000 short tons by the end of the year. Argentine exports of frozen whiting block to the United States jumped to 7,600 short tons during the first 6 months of 1978, as compared with the 1,500 short tons over the corresponding period in 1977. (Source: FFIR 79-1).

Soviet-Japan Fish Pact Sets 1979 Catch Quotas

The Soviet and Japanese government representatives in Tokyo on 15 December 1978 signed a protocol extending for another year the bilateral interim fishing agreements between the two nations. Fishery officials of both governments also exchanged notes on 1979 catch quotas in their respective 200-mile zones.

According to the new agreements, Japan will be allowed to catch a total 750,000 metric tons (t) in the Soviet 200-mile zone in 1979, down 100,000 t from 1978, whereas the Soviet's catch quota in Japan's 200-mile zone will remain unchanged from 1978 at 650,000 t.

Japan's catch quota for Alaska pollock, one of the most important species for its fishing industry, will drop from the previous 345,000 t to 300,000 t in 1979. Other significant cuts to Japan's catch quotas in the Soviet zone occurred for such species as flounder (cut from 30,300 to 20,900 t), rockfish (from 22,000 to 14,700 t), Pacific cod (from 44,700 to 30,100 t), and sand lance (from 65,200 to 43,800 t). The Soviet Union made a significant gain in the catch quota for sardine and Pacific mackerel in the Japanese zone for 1979, which is now set at 450,000 t as compared with the previous 318,000 t. A breakdown of 1979 catch quotas for the Soviet Union (Table 1) and Japan (Table 2) is shown in comparison with their respective 1978 figures. (Source: FFIR 79-1.)

Table 1.—Soviet catch quotas in Japanese zone, 1979 vs. 1978, in metric tons.

Species	1979	1978	Species	1979	1978
Sardine and mackerel	45,000	318,000	Saury	10.000	20,000
Alaska pollock	70.000	80.000	Sand lance	10.000	30.000
Itohikidara (Remonema)	90.000	138.000	Others	20.000	64.000
			Total	650,000	650,000

Table 2.—Japanese catch quotas in Soviet zone, 1979 vs. 1978, in metric tons.

Species	1979	1978	Species	1979	1978
Alaska pollock	300.000	345.000	Squid	142.900	146.400
Flounder	20.900	30.300	Octopus	3,600	3,500
Pacific cod	30.100	44.700	Tanner crab	2.500	2.500
Wachna cod	15.500	15.500	Red Tanner crab	2.500	2,300
Saury	68.600	68.600	Korean hair crab	800	800
Atka mackerel	11.300	11.000	Spiny crab	800	800
Sand lance	43.800	65.200	Shrimp	500	500
Shark	1,200	1.200	Snail	3,000	2.500
Tuna	6.400	6.400	Others	80.900	80.800
Rockfish	14.700	22.000	Total	750.000	850.000

Herring, Tanner Crab Prices Rise for Japan

Strong buying interest among Japanese importers early this year reportedly pushed up the prices of roe-bearing herring caught off San Francisco. February prices being charged by fishermen were reportedly as high as $1,600/short ton, sharply up from the season-opening price of around $1,200/short ton. With an estimated $450/short ton to be added by the packers, the import price into Japan may top FOB $2,000/short ton, according to an informed source in Japan.

Wholesale prices for size "L" shrink-packed tanner crab caught in Bristol Bay rose sharply since the end of last year in the western provinces of Japan due to unusually strong speculative buying among the buyers concerned over future supply. February prices were reported to be around ¥6,600/6 kg ($2.50/lb at ¥200=US$1), up from ¥5,900/6 kg ($2.23/lb) at the end of 1978 and ¥6,200-6,300/6 kg ($2.35-2.39/lb) early this year. Sizes above "2L" and below "M" were sold out by the end of last year. (Source: FFIR 79-2.)

Mexico-Japan Blackcod Fishery Gets Slow Start

Mexican-Japanese fishery joint venture "Abisal" is reportedly having a slow start in its blackcod fishery due to unfavorable oceanographic conditions at the fishing ground. Abisal's catch target of blackcod for 1979 is said to be 1,500 t.

A strong demand for blackcod in Japan has pushed the wholesale price for the fish caught in home waters to nearly ¥800/kg ($1.82/lb at ¥200=US$1). The price for imported blackcod would fall below this figure by approximately ¥105/kg (0.34/lb), according to an informed source. Annual demand for blackcod in Japan is believed to be between 40,000 and 50,000 t.

A Directory of Fisheries Agencies, Firms, Data, Sources, and Resources

The **American Fisheries Directory and Reference Book,** edited by Burton T. Coffey, seems aptly titled. The table of contents runs 9 pages alone and is divided into 7 sections with up to 15 chapters each.

Section I, "Geographic Fishery Regions," lists Federal and State offices dealing with fisheries, boating, and fishing-related matters for all coastal states, Great Lakes states, and selected landlocked states. Data is given on state fisheries and allied agencies, councils, and private groups, the state legislative bodies dealing with such matters, and commercial fisheries statistics. Selected fisheries publications are listed.

Section II, "Organizations," lists coastal commissions and associations of aquaculturists, boatbuilders, commercial fishermen and seafood processors, environmentalists, labor groups, marina operators, marine equipment manufacturers and professionals, marine law enforcers, oceanographers, researchers, sport fishermen, and trade groups.

Section III, the "International Directory," lists selected fishing nations, pertinent United Nations offices, and German and Japanese fish importers. Section IV, the "National Directory," lists Federal agencies and Congressional committees that deal with fisheries or maritime interests, and selected U.S. legislation bearing on fisheries, fishing or boating, etc. National and international fisheries commissions are also listed.

Section V tallies a wide variety of fisheries and marine equipment and services by product and by company; Section VI lists fisheries books and periodicals; and Section VII gives national and international fisheries statistics.

The 560-page soft-cover volume, in large (8½×11 inches) format, costs $40.00 and is available from the publisher, *National Fisherman*, Camden, ME 04842.

RESEARCH METHODS FOR CORAL REEFS

Coral Reefs: Research Methods has been published by Unesco, Paris, France, as the fifth volume in its series of monographs on oceanographic methodology to encourage the acceleration of coral reef research. Basic techniques are given for scientific studies of the quantitative ecology of coral reefs and effective methods are recommended.

The 581-page volume has 43 contributions broken into three parts: Part I, "Morphology and Structure"; Part II, "Biotic Distribution"; and Part III, "Energy and Nutrient Flux." Chapters in Part I detail reef terminology, mapping techniques, aerial photography and other remote sensing techniques, mechanical analysis of reef sediments, shallow core drilling, radiometric dating of coral reefs, sea level measurement techniques, and more.

Part II includes chapters on data collection and recording; quantitative benthic ecology; plotless, transect, and phytosociologic methods of reef measurement; and the study of sponges, Nemertina, reef fishes, and soft bottom communities. Part III includes methods of measuring coral growth, productivity, photosynthesis and respiration, and methods for determining chemical elements.

The publication was edited by D. R. Stoddart, Cambridge Universtiy, Cambridge, England, and R. E. Johannes, Hawaii Institute of Marine Biology, University of Hawaii, Kaneohe. It is available from Unipub, 345 Park Ave. South, New York, N.Y., for $30.00.

FOREIGN FISHERIES LEAFLETS AVAILABLE

The NMFS Office of International Fisheries has a limited supply of a number of Foreign Fishery Leaflets that were published in 1977 and 1978. Anyone interested in receiving a copy of the leaflets listed below may order them from the Foreign Fisheries Analysis Division (F41), Office of International Fishery Affairs, NMFS, NOAA, Commerce Department, Washington, DC 20235. Requests will be honored as long as the supply lasts.

The Foreign Fishery Leaflets still available are: FFL 77/3, "Fishery Statistics of Japan, 1975"; FFL 77/4, "Southern Africa's Fishing Industry, 1975-77"; FFL 77/5, "The Lobster Fishery in the Republic of South Africa and Namibia, 1975-76"; FFL 77/6, "The Fisheries of Angola, 1974-76"; FFL 78/1, "The Fisheries of Tunisia, 1976"; FFL 78/2, "The Brazilian Lobster Fishery, 1976"; FFL 78/3, "The Fisheries of Senegal, 1975-76"; FFL 78/4, "The Fisheries of Kenya, 1975"; and FFL 78/6, "The Fisheries of Gambia, 1977". Please enclose a self-addressed label to facilitate mailing.

FISH DISEASES AND THEIR PREVENTION

Fish Pathology, edited by Ronald J. Roberts, and published by Balliere Tindall, London, England, is a new text on the study and prevention of fish diseases. It is intended to "provide the background information, from the other disciplines, for the veterinarian, aquaculturist, microbiologist, parasitologist, nutritionist, or hydrologist who is involved in fish diseases." Roberts is Reader in Animal Biology, Director of the Unit of Aquatic

Pathobiology, University of Stirling, Scotland, and editor of the *Journal of Fish Diseases*.

Roberts begins with a discussion of the aquatic environment and how it influences disease, then progresses to anatomy and physiology of teleosts, their pathophysiology and systematic pathology. Other chapters discuss immunology, neoplasia, virology, parasitology, bacteriology, mycology, and nutritional pathology. Miscellaneous noninfectious diseases (i.e., problems related to water tempertaure, nitrogen supersaturation, traumatic injuries, genetics, etc.) are briefly discussed. Laboratory methods used in fish pathology studies are reviewed as are treatments for fish diseases and the relationships of fish culture and management to diseases.

"Fish Pathology", with 250 figures, 318 pages, distributed in the United States by Lea & Febiger, 600 Washington Square, Philadelphia, PA 19106, costs $64.00.

Brazil's Fish Catch Up 5 Percent in 1978

Brazilian fishermen caught an estimated 884,000 metric tons (t) of fish and shellfish in 1978, a 5 percent increase over the 843,000 t[1] landed in 1977. Government estimates indicate that Brazilian marine fishermen could catch between 1.4 and 1.6 million t of fish and freshwater fishermen and aquaculturists could produce between 0.8 and 4.0 million t. The country's Third National Fisheries Development Plan (PNDP) will be completed in 1979 and the fisheries agency, SUDEPE, is now planning the Fourth PNDP.

J. Rodriguez and J. Silva of the U.S. Embassy in Brasilia have prepared a 34-page report on the Brazilian fishing industry. The report includes information on catch, vessels, fishermen, processing, marketing, development programs, tuna, shrimp, whales, lobster, catfish, sardines, exports, and imports. A copy of the report can be obtained by purchasing report DIB-79-03-004 for $4.00 from: National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

[1]Does not include subsistence and recreational catches.

Tokyo Wholesale Fish Market Data Released

The Tokyo Metropolitan Government has published a 10-page brochure entitled "The Tokyo Central Wholesale Market In Brief, 1978". The market, which has 11 regional and 7 branch markets in the Tokyo Metropolitan Area, handled over 830,000 t of fresh and processed marine products worth $2.6 billion in 1977.

The brochure includes a brief history of the Market, its organization, a distribution flow chart, a floor plan, statistical data on transactions, and the main features of its regional and branch markets. Copies may be obtained by writing to the Information and Publication Section, Tokyo Central Wholesale Market, 2-1, Tsukigi 5-chome, Chuo-ku, Tokyo, Japan. Information on the publication's cost, if any, was unavailable.

Ecuador's Fishing Industry, 1977-78

Ecuadorian fishermen caught 475,000 metric tons (t) of fish and shellfish in 1977, more than a 50 percent increase over the 315,000 t caught in 1976. Most of the increase was due to the increased landings of Pacific thread herring ("pinchagua") and other species used principally for reduction to fish meal. The Government is now considering the imposition of catch quotas.

About 8,600 t of shrimp was landed in 1976. Tuna landings increased from 25,000 t in 1976 to 28,000 t in 1977. A number of foreign companies and governments (including the United States, Japan, Poland, France, the United Kingdom, and Spain) have contacted Ecuadorian officials concerning various fishery development projects. In addition, funding has recently been obtained for a $17.8 million fisheries project which will be administered by the state-owned company, EPNA.

The U.S. Consulate General in Guayaquil, Ecuador, has submitted a detailed 40-page report on Ecuadorian fisheries. The report includes sections on Ecuador's Fishing Development Program, major recent developments, foreign interests in Ecuadorian fisheries, plans to build new ports, the State-owned fishing company (EPNA), and a section on the major fisheries (shrimp, tuna, pelagic, and demersal species). The report can be purchased for $4.50 by ordering document number DIB-79-03-006 from: National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

ROK, Australian Fishery Market Reports Printed

The U.S. Embassy in Seoul, Republic of Korea, and the U.S. Consulate General in Sydney, Australia, have prepared market reports on fishing gear and equipment for South Korea and Australia, respectively. The 13-page report on Korea states that the best potential for U.S. sales of fishing equipment and vessels is in South Korea's deep-sea fisheries sector which is slated to expand considerably by 1981.

The 52-page market report on Australia states that limited opportunities exist for U.S. suppliers of electronic fish finding equipment, communication devices, and fish processing machinery, and suggests that interested U.S. firms might want to participate and display equipment at the Fish Expo Exhibition to be held in Perth, 26-29 August 1979.

Both reports can be purchased from the National Technical Information Service (NTIS), Springfield, VA 22161 by ordering: DIB-78-11-012, "Market Brief-Fishing Equipment, Republic of Korea," (cost, $4.00); DIB 78-11-014 "Market Research Concerning Fishing/Fish Processing Sector; Potential for Fish Expo Participation, Australia," (cost, $5.25).

Editorial Guidelines for *Marine Fisheries Review*

Marine Fisheries Review publishes review articles, original research reports, significant progress reports, technical notes, and news articles on fisheries science, engineering, and economics, commercial and recreational fisheries, marine mammal studies, aquaculture, and U.S. and foreign fisheries developments. Emphasis, however, is on in-depth review articles and practical or applied aspects of marine fisheries rather than pure research.

Preferred paper length ranges from 4 to 12 printed pages (about 10-40 manuscript pages), although shorter and longer papers are sometimes accepted. Papers are normally printed within 4-6 months of acceptance. Publication is hastened when manuscripts conform to the following recommended guidelines.

The Manuscript

Submission of a manuscript to *Marine Fisheries Review* implies that the manuscript is the author's own work, has not been submitted for publication elsewhere, and is ready for publication as submitted. Commerce Department personnel should submit papers under completed NOAA Form 25-700.

Manuscripts must be typed (double-spaced) on high-quality white bond paper and submitted with two duplicate (but not carbon) copies. The complete manuscript normally includes a title page, a short abstract (if needed), text, literature citations, tables, figure legends, footnotes, and the figures. The title page should carry the title and the name, department, institution or other affiliation, and complete address (plus current address if different) of the author(s). Manuscript pages should be numbered and have 1½-inch margins on all sides. Running heads are not used. An "Acknowledgments" section, if needed, may be placed at the end of the text. Use of appendices is discouraged.

Abstract and Headings

Keep titles, heading, subheadings, and the abstract short and clear. Abstracts should be short (one-half page or less) and double-spaced. Paper titles should be no longer than 60 characters; a four- to five-word (40 to 45 characters) title is ideal. Use heads sparingly, if at all. Heads should contain only 2-5 words; do not stack heads of different sizes.

Style

In style, *Marine Fisheries Review* follows the "U.S. Government Printing Office Style Manual." Fish names follow the American Fisheries Society's Special Publication No. 6, "A List of Common and Scientific Names of Fishes from the United States and Canada," third edition, 1970. The "Merriam-Webster Third New International Dictionary" is used as the authority for correct spelling and word division. Only journal titles and scientific names (genera and species) should be italicized (underscored). Dates should be written as 3 November 1976. In text, literature is cited as Lynn and Reid (1968) or as (Lynn and Reid, 1968). Common abbreviations and symbols such as mm, m, g, ml, mg, and °C (without periods) may be used with numerals. Measurements are preferred in metric units; other equivalent units (i.e., fathoms, °F) may also be listed in parentheses.

Tables and Footnotes

Tables and footnotes should be typed separately and double-spaced. Tables should be numbered and referenced in text. Table headings and format should be consistent; do not use vertical rules.

Literature Citations

Title the list of references "Literature Cited" and include only published works or those actually in press. Citations must contain the complete title of the work, inclusive pagination, full journal title, the year and month and volume and issue numbers of the publication. Unpublished reports or manuscripts and personal communications must be footnoted. Include the title, author, pagination of the manuscript or report, and the address where it is on file. For personal communications, list the name, affiliation, and address of the communicator.

Citations should be double-spaced and listed alphabetically by the senior author's surname and initials. Co-authors should be listed by initials and surname. Where two or more citations have the same author(s), list them chronologically; where both author and year match on two or more, use lowercase alphabet to distinguish them (1969a, 1969b, 1969c, etc.).

Authors must double-check all literature cited; they alone are responsible for its accuracy.

Figures

All figures should be clearly identified with the author's name and figure number, if used. Figure legends should be brief and a copy may be taped to the back of the figure. Figures may or may not be numbered. Do not write on the back of photographs. Photographs should be black and white, 8- × 10-inches, sharply focused glossies of strong contrast. Potential cover photos are welcome but their return cannot be guaranteed. Magnification listed for photomicrographs must match the figure submitted (a scale bar may be preferred).

Line art should be drawn with black India ink on white paper. Design, symbols, and lettering should be neat, legible, and simple. Avoid freehand lettering and heavy lettering and shading that could fill in when the figure is reduced. Consider column and page sizes when designing figures.

Finally

First-rate, professional papers are neat, accurate, and complete. Authors should proofread the manuscript for typographical errors and double-check its contents and appearance before submission. Mail the manuscript flat, first-class mail, to: Editor, *Marine Fisheries Review*, Scientific Publications Office, National Marine Fisheries Service, NOAA, 1107 N.E. 45th Street, Room 450, Seattle, WA 98105.

The senior author will receive 50 reprints (no cover) of his paper free of charge and 100 free copies are supplied to his organization. Cost estimates for additional reprints can be supplied upon request.

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